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Anatomical Characteristics of Lodgepole Pine Trees In North America

by Edwin J. Burke

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ANATOMICAL CHARACTERISTICS OF LODGEPOLE PINE TREES IN NORTH AMERICA

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INTRODUCTION

Lodgepole pine (Pinus contorta Dougl. ex Loud.) occupies nearly 13 million acres (5 million ha) of commercial forest land in the United States, and 50 million acres (20 million ha) in Canada. Four varieties (contorta, murrayana, contorta and bolanderi) are recognized, although only contorta and murrayana attain sizes and stem forms conducive to utilization for products.

The variety latifolia accounts for a large majority of the lodgepole pine resource of North America. Centering along the Rocky Mountains, its range extends north from southern Colorado north to the Northwest Territories. Variety murrayana has a significantly smaller range, following the Sierra Nevada mountains of California north into Oregon.

The anatomical characteristics of the species have never been studied in depth or with attention paid to the comparisons of characteristics throughout the latitudinal or elevational range of the species. Comparisons of all the cellular characteristics of the different varieties have never been made, and even within-tree variation analysis of the charactaristics is lacking.

This study used stem and root material collected in a previous project designed to provide material for anatomical, mechanical and chemical characterization studies. Procedures and results of the collection and initial gross characterizations and literature review are reported by Dr. Peter Koch in General Technical Report INT-227.

EXPERIMENTAL PROCEDURE

CHARACTERISTICS STUDIED

The nineteen anatomical characteristics studied (later serving as dependent variables in the statistical analyses) were:

EARLYWOOD	LATEWOOD
fiber length	fiber length
microfibril angle	microfibril angle
tangential cell diameter	tangential cell diameter
tangential lumen diameter	tangential lumen diameter
tangential wall thickness	tangential wall thickness
radial cell diameter	radial cell diameter
radial lumen diameter	radial lumen diameter
radial wall thickness	radial wall thickness

resin canal number/cm^2
resin canal diameter
percentage latewood/ annual increment

These characteristics were studied in 10 above-ground locations in 10 percent increments from 0 to 90 percent, one ground-level (stump), and two below-ground locations of taproot and lateral roots. For variety latifolia, 3 trees of each of 3 diameters (3, 6 and 9 inches dbh) from 3 elevations (low, medium and high) from each of 9 latitudes (40 through 60.0 degrees) resulted in the sampling of 243 trees.

Trees of variety murrayana were collected from 4 latitudes, 37.5, 40.0, 42.5 and 45 degrees, and only at medium elevation. The same three diameters and number of replications were available, allowing for sampling of 36 trees.

SELECTION OF SPECIMENS FROM DISKS

Areas on the disks removed during the initial collection were chosen for sampling by use of a plasic grid-overlay. This overlay randomly located areas to be sampled for the various characteristics, and indicated a number of sample areas proportionate to the diameter of the disk. Thus, the random sample was weighted for diameter of the disk (tree volume). It should also be noted that while some of the disks contained compression wood, all efforts were made to avoid sampling in these areas.

CHARACTERISTICS-MEASUREMENT TECHNIQUES

Tracheid Length and Microfibril Angle

Specimens for determination of tracheid length and microfibril angle for both earlywood and latewood were prepared by first extracting 1mm x 1mm slivers whose length corresponded to the thickness of 30-degree wedges extracted from the sections taken from the disks removed from 13 locations throughout the aerial and below-ground portions of each tree. The dot-grid template was overlaid the disk to locate the sampling points, thus allowing weighted, random sampling.

The slivers were then macerated using peracetic acid, stained and mounted on glass slides for measurement of length (+/- 0.1mm) and microfibril angle (+/- 1 degree), as determined by ray cross-field pitting alignment.

Latewood Percentage

Latewood percentage was determined through weighted sampling of different locations on the sample disks using an incident light microscope and calibrated stage and eyepiece reticule; or with thin sections, measured with a transmission light microscope and

calibrated stage and eyepiece reticule; or thin sections measured with a projection microscope and calibrated scale. The specimen-measurement technique was based on the thickness of the sample disk, with thicker disks being thin-sectioned. Preliminary tests showed that both methods of measurement showed results with no statistical difference.

Resin Canal Number and Diameter

Determinations of resin canal numbers and diameters were made using an incident-light microscope to examine microtome- knife prepared wood cubes, or light microscopic examination and measurement of thin sections. The cubes and sections were the same as those used to determine latewood percentage. Resin canal numbers were reported based on observations of 0.25 cm^2 areas, randomly selected using an overlay grid. Resin canal diameters were reported to the nearest micrometer.

Transverse Cell Dimensions

Tangential and radial cell and lumen diameters were determined using the same microtome knife-surfaced cubes or the thin sections made for the latewood percentage and resin canal characteristics. Outside cell dimensions (radial and tangential) were measured to the nearest micrometer, as were lumen diameters. Tangential and radial wall thicknesses were determined by subtraction, and also reported to the nearest micrometer. Mean tangential wall thickness was determined by subtracting the mean radial lumen diameter from the mean radial cell diameter, while mean radial wall thickness was determined by subtracting the mean tangential lumen diameter from the mean tangential cell diameter.

STATISTICAL ANALYSIS

The statistical data analysis was divided into two phases. Phase 1 was conducted by location in the tree for the thirteen stem, stump and root locations. Phase 2 used tree averages for four locations where one of the locations was a weighted average of the zero to 90 percent heights in the stem.

Phase 1 Analysis

The first part of Phase 1, by all locations in the tree, was analysis of variance for both varieties and each of the 19 measured variables. The format of the analysis of variance tables for the two varieties follows:

var. latifolia:

Source	Degrees of freedom
Latitude (L)	8
Elevation (E)	2
Diameter (D)	2
LxE	16
LxD	16
ExD	4
LxExD	32
Error	162
Total	242

var. murrayana

Source	Degrees of freedom
Latitude (L)	3
Diameter (D)	2
LxD	6
Error	24
Total	35

The next part of Phase 1 involved the computation of means, with some pooling, for each of the nineteen variables. The means were also plotted with results for both varieties displayed together. Variety latifolia had latitudes and elevations pooled (each data point based on n=81) while variety murrayana had only latitudes pooled, yielding plotted data points based on n=12.

Correlations of each variable at each location with nine characteristics from the Master Data File (compiled when the trees were originally sampled and measured) were computed in two ways. First, they were calculated by each location separately. Second, the 2,430 latifolia sections (243 trees x 10 bole heights) and the 360 murrayana sections (36 trees x 10 bole heights) were used. The nine characteristics from Genereral Technical Report INT-227 correlated with the nineteen variables of this study were:

stembark thickness (mm)
stembark specific gravity
stembark moisture content (%)
stemwood moisture content (%)
stemwood specific gravity
stemwood diameter
pith eccentricity (mm)
stemwood volumetric percentage compression wood (%)
stemwood out-of-round index

The last part of Phase 1 was a comparison of the two varieties, using a t-test or approximate t-test (when variances were unequal) for each of the 19 variables. These results are tabled and plotted as Figures in order to illustrate the between-variety differences as well as the earlywood/latewood differences.

Phase 2 Analysis

Phase 2 of the analysis was conducted using tree-averages for stemwood values determined by cross-sectional area weighting of the original discs used as anatomical- characteristics specimen sources. The first round of Phase 2 analyses used tree averages and was conducted with the earlywood and latewood fiber characteristics pooled as would be the case in a utilization setting using wood chips as a source of fiber (pulping, fiberboard, particleboard). Each of the eight variables that were the result of earlywood/latewood pooling and the three variables that were not (latewood percentage, resin canal number and resin canal diameter) were subjected to an analysis of variance. In addition, appropriate summary tables of means, standard deviations and ranges are presented.

The two varieties were also compared over the three latitudes they had in common (40, 42.5 and 45 degrees N. latitude). The following summary illustrates this analysis.

Source	Degrees of Freedom
Variety (V)	1
Latitude (L)	2
Diameter (D)	2
VxL	2
VxD	2
LxD	4
VxLxD	4
Error	36
Total	53

Correlations were calculated for the 11 variables with the characteristics from the Master Data File (INT-227) in Table 1.

TABLE 1

Characteristics used for the correlation analysis:

latitude (deg)
longitude (deg)
longitude zone
elevation (m)
dbh (mm)
heartwood diam at 6-inch stump (mm)
tree age at 6-inch stump (yrs)
tree height to apical tip (m)
taproot length (m)
live crown width (m)
live crown length (m)
stem crook (mm)
number of live branches
live branch angle (deg)
number of dead branches

stembark thickness at 6-inch stump (mm)
central root bark thickness (mm)
lateral root bark thickness (mm)
stump bark thickness (mm)
average ring width at 6-inch stump (mm)
total cones on first lineal ft of top 25 branches

stem taper inside bark from 6-inch stump to base of live crown (mm/m)
crown ratio

ovendry stemwood weight (g)
ovendry sapwood weight (g)
ovendry heartwood weight (g)

complete-tree ovendry weight (g)
stemwood specific gravity
stembark specific gravity

stemwood moisture content (pct)
stembark moisture content (pct)
stem sapwood moisture content (pct)
stumpwood moisture content (pct)

lateral rootwood moisture content (pct)
taproot moisture content (pct)

ovendry complete-tree weight proportions, fraction of complete-tree weight :

- stem with bark
- branches (live and dead) with no foliage
- stump-root system
- foliage

tree-average percent compression wood in stem
tree-average e/r1 for stemwood

After compilation, values were screened for significance at the 5% level and only significant results reported.

Next, the means for the 11 variables for the 243 latifolia trees were compared with the means of the 36 murrayana trees using the t-test or the approximate t-test (vhen variances were unequal).

The second round of Phase 2 used the same techniques as detailed above, but separated eight of the variables into earlywood and latewood. Thus, there were 16 variables tested (percentage latewood, resin canal number/area and resin canal diameter could not be separated and had already been analyzed).

RESULTS AND DISCUSSION

The results of the analyses are presented by variable, listing the results of the anaylses of variance (ANOVA) pertaining to that variable. Phase 1 includes figures and care must be taken not to infer statistical significance to the presence of discreetly separated lines connecting plotted points. Separation of the lines does not constitute statistically significant differences. Reference to the explanatory table must be made to determine if differences are present. The ANOVA summaries are identified by title, and precede the appropriate figures, if present.

PHASE 1: WITHIN-TREE ANALYSIS

Within-tree values for earlywood and latewood wood and cell properties for var. murrayana, and var. latifolia are reported in this section. Tables 2 and 3 present the average values of the nineteen variables by diameter and height in the trees for both latifolia and murrayana. Figures graphically depict the effect of position in the tree with the earlywood and latewood properties depicted in separate figures, and a figure showing the relationship between the varieties for the different locations in the tree immediately following. Results are summarized in the listing of ANOVA results preceding the Figures.

TABLE 2.

LATIFOLIA -- AVERAGES BY DIAMETER AND PERCENTAGE HEIGHT IN TREE -- LATITUDES AND ELEVATIONS POOLED (n=81)

DIAM	LR	TR	ST	0	10	20	30	40	50	60	70	80	90
						latewood fiber length							
3	2.5	2.7	3.1	2.3	2.4	2.4	2.5	2.5	2.5	2.4	2.3	2.3	2.1
6	2.5	2.7	3.1	2.8	2.9	2.9	2.9	2.9	2.9	2.9	2.8	2.7	2.5
9	2.5	2.7	3.1	2.4	2.6	2.6	2.7	2.7	2.6	2.5	2.5	2.5	2.3
						latewood microfibril angle							
3	27.8	25.9	23.9	22.3	22.7	21.8	21.9	21.9	21.9	20.6	20.7	22.0	23.8
6	28.4	26.2	23.8	22.2	22.0	22.1	21.3	22.4	22.1	22.6	22.4	23.2	24.1
9	27.7	25.8	24.6	22.2	21.4	21.4	21.8	22.1	21.1	21.5	21.7	21.5	22.4
						latewood percent							
3	9.9	10.5	12.8	14.6	15.1	15.4	15.2	15.0	14.7	13.7	13.4	12.2	11.0
6	9.4	10.3	12.8	15.0	15.0	15.3	15.2	14.6	13.8	13.8	13.0	12.1	11.4
9	9.7	9.8	12.1	15.2	16.4	15.9	15.2	15.0	14.2	13.7	12.6	11.9	11.1
						resin canal number							
3	38.3	38.1	37.7	35.9	37.3	37.9	37.9	39.1	38.9	39.3	39.3	37.6	37.4
6	36.5	39.3	39.4	35.2	35.6	37.4	38.0	38.1	37.5	37.1	36.9	37.2	36.8
9	38.8	39.9	38.5	36.1	37.5	36.0	37.9	38.7	40.5	38.3	36.0	38.6	37.5
						resin canal diameter							
3	71.2	71.6	73.2	70.6	71.7	71.2	71.9	72.8	73.0	72.2	71.4	73.1	73.4
6	70.6	72.5	72.7	71.2	71.7	71.7	72.7	72.9	73.4	73.2	72.4	73.0	73.0
9	70.3	72.6	72.2	71.1	71.5	71.0	72.1	71.9	72.6	72.7	73.0	72.5	71.6
						earlywood fiber length							
3	1.9	2.1	2.4	1.9	1.9	2.0	2.0	2.1	2.0	2.0	2.0	1.9	1.8
6	1.9	2.1	2.4	2.2	2.3	2.4	2.4	2.4	2.4	2.3	2.2	2.2	2.0
9	1.9	2.1	2.3	2.0	2.1	2.2	2.2	2.2	2.2	2.1	2.1	2.1	1.9
						earlywood microfibril angle							
3	34.6	33.3	31.3	27.4	28.7	26.7	28.0	28.2	26.9	27.0	27.1	28.0	28.2
6	34.9	32.8	31.5	27.8	28.4	28.4	27.5	29.4	28.3	29.3	29.5	30.4	30.4
9	34.7	33.2	31.4	27.1	26.8	26.2	27.3	27.6	27.5	26.7	26.1	26.7	27.3
						latewood tangential cell diameter							
3	26.7	26.3	27.0	27.1	27.8	27.6	27.5	28.0	27.1	27.2	27.1	26.8	27.5
6	26.3	26.9	27.4	27.5	27.7	27.9	28.3	28.4	28.1	27.7	27.8	27.2	27.3
9	25.9	26.4	27.5	27.6	27.9	28.4	28.8	28.6	28.4	28.3	28.6	28.3	28.0
						latewood tangential lumen diameter							
3	19.5	18.8	18.6	17.4	18.0	17.6	18.0	18.4	18.0	18.1	18.3	18.5	19.4
6	19.1	19.1	18.8	18.2	18.2	18.2	18.7	18.9	18.7	18.6	19.0	18.9	19.2
9	18.6	18.8	18.9	17.9	18.0	18.6	19.1	19.0	18.8	19.1	19.8	20.0	19.8
						latewood tangential wall thickness							
3	3.6	3.7	4.2	4.8	4.9	5.0	4.8	4.8	4.6	4.5	4.4	4.2	4.0
6	3.6	3.8	4.3	4.7	4.7	4.8	4.8	4.8	4.7	4.5	4.4	4.2	4.0
9	3.7	3.8	4.3	4.8	4.9	4.9	4.9	4.8	4.8	4.6	4.4	4.2	4.1

TABLE 2 (cont.)

LATIFOLIA -- AVERAGES BY DIAMETER AND PERCENTAGE HEIGHT IN TREE -- LATITUDES AND ELEVATIONS POOLED (n=81)

DIAM	LR	TR	ST	0	10	20	30	40	50	60	70	80	90
						latewood radial cell diameter							
3	19.2	19.0	19.8	20.6	20.7	20.5	20.1	20.5	20.2	20.1	20.2	19.9	20.4
6	19.4	19.6	20.0	20.8	20.9	21.0	20.9	21.1	20.6	20.6	20.3	20.2	20.1
9	18.8	19.1	20.5	20.7	20.7	21.1	21.4	21.2	21.1	20.9	21.5	21.1	20.6
						latewood radial lumen diameter							
3	13.9	13.4	13.7	13.1	13.2	12.7	12.6	13.1	13.2	13.2	13.4	13.4	14.2
6	13.7	13.6	13.4	14.0	13.6	13.5	13.4	13.6	13.2	13.4	13.4	13.6	13.9
9	13.4	13.6	14.3	13.3	13.1	13.7	13.9	13.8	14.1	14.0	15.0	14.8	14.3
						latewood radial wall thickness							
3	2.7	2.8	3.1	3.7	3.8	3.9	3.8	3.7	3.5	3.5	3.4	3.2	3.1
6	2.8	3.0	3.3	3.4	3.6	3.8	3.8	3.7	3.7	3.6	3.4	3.3	3.1
9	2.7	2.8	3.1	3.7	3.8	3.7	3.7	3.7	3.5	3.4	3.3	3.1	3.1
						earlywood tangential cell diameter							
3	32.5	32.3	33.0	33.3	34.1	34.4	34.2	34.3	34.6	33.9	34.1	33.1	33.5
6	32.3	32.9	33.5	33.1	33.7	34.2	34.9	35.1	34.0	34.5	34.0	33.7	33.6
9	32.3	33.0	33.6	34.0	34.6	34.9	35.2	35.1	34.8	35.1	34.6	35.2	34.4
						earlywood tangential lumen diameter							
3	28.9	28.6	28.8	28.5	29.3	29.5	29.5	29.6	30.0	29.4	29.6	28.9	29.4
6	28.6	29.1	29.0	28.4	29.0	29.2	30.0	30.3	29.3	29.9	29.6	29.4	29.5
9	28.6	29.1	29.4	29.1	29.7	30.1	30.5	30.3	30.0	30.4	30.1	30.9	30.1
						earlywood tangential wall thickness							
3	1.8	1.8	2.1	2.4	2.4	2.4	2.4	2.4	2.3	2.3	2.3	2.1	2.0
6	1.8	1.9	2.2	2.4	2.4	2.5	2.4	2.4	2.3	2.3	2.2	2.1	2.0
9	1.8	1.9	2.1	2.4	2.5	2.4	2.4	2.4	2.4	2.3	2.3	2.1	2.2
						earlywood radial cell diameter							
3	34.0	33.8	34.3	35.2	35.8	36.0	36.1	35.8	36.2	35.6	36.1	34.9	34.7
6	34.3	34.9	35.4	35.1	35.5	35.9	36.7	36.7	35.8	36.1	36.0	35.9	35.5
9	34.7	35.5	36.1	36.2	36.8	37.1	37.1	37.4	37.0	37.1	36.5	37.1	36.6
						earlywood radial lumen diameter							
3	31.3	31.0	31.2	31.6	32.1	32.3	32.4	32.0	32.9	32.1	32.7	31.8	31.7
6	31.6	32.1	32.2	31.6	31.8	32.2	33.0	33.0	32.1	32.5	32.6	32.6	32.4
9	32.0	32.6	33.0	32.7	33.1	33.4	33.5	33.9	33.4	33.6	33.2	34.1	33.5
						earlywood radial wall thickness							
3	1.3	1.4	1.6	1.8	1.8	1.9	1.8	1.8	1.7	1.7	1.7	1.5	1.5
6	1.4	1.4	1.6	1.8	1.9	1.8	1.8	1.8	1.8	1.8	1.7	1.7	1.5
9	1.3	1.4	1.6	1.8	1.8	1.8	1.8	1.7	1.8	1.8	1.6	1.5	1.5

TABLE 3

MURRAYANA -- AVERAGES BY DIAMETER AND PERCENTAGE HEIGHT IN TREE -- LATITUDES POOLED (n=12)

DIAM	LR	TR	ST	0	10	20	30	40	50	60	70	80	90
						latewood fiber length							
3	2.7	2.8	3.1	3.6	3.5	3.6	3.7	3.8	3.7	3.5	3.3	3.4	3.2
6	2.4	2.7	3.2	3.3	3.4	3.6	3.6	3.5	3.6	3.4	3.4	3.4	3.1
9	2.5	2.9	3.1	3.3	3.5	3.6	3.6	3.6	3.7	3.6	3.4	3.3	3.2
						latewood microfibril angle							
3	26.0	25.6	25.2	18.0	18.5	18.7	19.6	19.8	17.8	18.9	19.3	20.8	19.8
6	30.2	28.3	26.5	18.5	18.6	18.6	18.0	18.3	18.4	18.2	17.5	17.8	19.1
9	30.5	29.2	27.7	18.1	17.9	16.8	17.6	18.9	16.7	17.3	18.5	19.8	20.3
						latewood percent							
3	11.6	11.6	12.0	18.3	18.7	20.1	18.1	18.3	15.4	15.1	14.2	13.8	12.8
6	12.2	14.3	14.5	17.6	19.8	18.1	19.4	17.3	17.2	16.5	12.8	13.7	14.3
9	11.2	12.4	12.9	15.6	16.3	16.2	16.7	17.7	14.5	14.8	14.8	14.4	12.7
						resin canal number							
3	34.7	36.1	37.8	36.6	39.3	39.7	38.8	36.8	40.9	40.7	37.9	38.8	36.3
6	30.8	34.4	32.8	29.7	31.7	33.7	34.5	30.3	33.7	34.0	36.2	36.3	33.9
9	33.9	32.3	35.0	34.4	34.8	35.7	34.1	35.3	35.8	34.8	34.5	34.9	36.3
						resin canal diameter							
3	73.4	73.0	74.8	72.8	73.8	73.5	71.0	74.4	78.3	75.6	76.8	76.3	75.3
6	73.7	74.0	71.7	68.2	70.3	73.5	73.4	73.8	75.0	75.7	75.7	73.5	71.2
9	72.0	71.9	74.5	74.1	72.1	71.5	73.6	74.1	78.0	75.6	77.7	72.8	75.7
						earlywood fiber length							
3	2.3	2.4	2.6	2.5	2.6	2.8	2.8	2.8	2.8	2.7	2.6	2.7	2.6
6	1.9	2.2	2.3	2.5	2.5	2.6	2.7	2.7	2.7	2.7	2.5	2.5	2.4
9	2.2	2.4	2.6	2.6	2.8	2.7	2.8	2.7	2.7	2.7	2.6	2.6	2.6
						earlywood microfibril angle							
3	36.4	34.2	33.1	26.3	27.8	28.2	28.0	27.2	26.5	24.9	26.2	27.3	27.8
6	36.6	34.5	31.8	27.8	26.7	26.9	27.2	26.5	26.0	25.8	27.8	28.8	27.9
9	33.4	33.8	35.6	26.5	26.7	25.8	25.9	27.3	26.3	25.5	26.5	27.0	28.4
						latewood tangential cell diameter							
3	27.6	27.6	28.5	26.3	26.8	27.0	27.2	28.3	29.0	29.3	28.1	27.8	27.9
6	27.8	27.5	28.5	28.9	28.8	29.7	29.2	29.8	31.8	30.9	31.5	31.3	28.7
9	26.3	27.3	29.3	28.3	29.9	30.3	29.6	31.3	30.3	30.2	30.0	31.3	29.8
						latewood tangential lumen diameter							
3	21.2	20.1	20.1	18.0	18.5	18.4	19.4	19.8	20.0	21.0	19.8	19.4	19.8
6	21.0	20.8	21.3	20.4	21.0	20.4	19.4	20.9	22.9	22.4	23.0	23.3	20.8
9	19.6	20.4	22.6	19.8	21.5	21.4	21.2	22.6	22.4	21.9	21.2	22.7	21.9
						latewood tangential wall thickness							
3	3.2	3.3	3.8	4.2	4.1	4.3	4.0	4.3	4.5	4.2	4.2	4.2	4.0
6	3.4	3.4	3.6	4.3	4.3	4.6	4.9	4.5	4.5	4.3	4.3	4.0	3.9
9	3.4	3.5	3.4	4.2	4.2	4.4	4.2	4.3	3.9	4.1	4.0	3.9	3.9

TABLE 3 (cont.)

MURRAYANA -- AVERAGES BY DIAMETER AND PERCENTAGE HEIGHT IN TREE -- LATITUDES POOLED (n=12)

DIAM	LR	TR	ST	0	10	20	30	40	50	60	70	80	90
						latewood radial cell diameter							
3	20.8	21.9	22.6	20.5	20.1	20.4	20.7	21.3	22.5	23.1	21.4	21.4	22.7
6	20.8	20.8	21.4	20.4	21.4	21.3	20.6	21.6	23.7	23.8	22.8	23.2	21.8
9	20.0	20.5	22.8	21.6	23.7	23.0	22.8	24.5	23.2	23.3	23.3	24.3	22.9
						latewood radial lumen diameter							
3	15.8	16.9	16.8	14.2	13.3	13.3	14.3	14.8	15.7	16.1	15.0	15.4	16.8
6	15.5	15.1	15.5	14.4	14.8	14.3	13.4	14.3	16.6	17.3	16.3	16.7	15.5
9	15.1	15.5	17.7	15.3	17.5	17.3	16.8	18.3	17.1	17.3	17.4	18.7	16.8
						latewood radial wall thickness							
3	2.5	2.5	2.9	3.2	3.4	3.6	3.2	3.3	3.4	3.5	3.2	3.0	2.9
6	2.7	2.9	3.0	3.0	3.3	3.5	3.6	3.6	3.5	3.2	3.3	3.3	3.1
9	2.5	2.5	2.5	3.1	3.1	3.0	3.0	3.1	3.0	3.0	3.0	2.8	3.1
						earlywood tangential cell diameter							
3	31.5	32.6	33.8	32.3	32.2	33.0	33.0	35.0	35.3	33.9	34.5	35.1	33.7
6	30.3	30.7	32.3	32.4	32.4	32.4	31.8	32.5	33.9	33.1	35.4	33.5	33.1
9	30.7	31.5	32.8	33.0	33.8	33.6	33.7	35.0	34.3	33.8	34.1	34.3	33.8
						earlywood tangential lumen diameter							
3	28.0	29.3	29.9	28.5	27.9	28.7	28.9	30.7	30.9	29.3	30.2	30.8	29.5
6	26.9	26.5	28.3	28.4	28.1	27.6	27.2	28.1	29.4	28.5	30.9	29.2	28.2
9	27.0	27.8	29.2	28.8	29.2	29.3	29.3	30.3	30.4	29.8	29.9	30.4	30.1
						earlywood tangential wall thickness							
3	1.8	1.6	2.0	1.9	2.1	2.2	2.0	2.2	2.2	2.3	2.2	2.2	2.1
6	1.7	2.1	2.0	2.0	2.2	2.4	2.3	2.2	2.3	2.3	2.3	2.2	2.0
9	1.8	1.8	1.8	2.1	2.3	2.1	2.2	2.3	1.9	2.0	2.1	2.0	1.9
						earlywood radial cell diameter							
3	32.7	34.2	34.3	34.2	33.4	33.8	35.3	35.3	36.7	35.3	35.4	36.5	35.0
6	33.3	33.3	35.8	33.4	34.0	34.4	34.4	34.0	35.7	35.2	36.0	36.8	35.4
9	32.0	32.4	34.7	34.0	35.0	34.7	35.1	36.2	35.3	35.3	35.2	35.8	35.5
						earlywood radial lumen diameter							
3	30.3	31.8	31.4	31.1	30.1	30.8	32.1	31.8	32.9	31.8	32.1	33.2	32.1
6	30.7	29.9	32.9	30.2	30.6	30.5	30.7	30.2	31.9	31.6	32.3	33.2	31.3
9	29.3	29.6	31.8	30.9	31.5	31.4	31.7	32.8	32.5	32.1	31.8	32.8	32.9
						earlywood radial wall thickness							
3	1.2	1.2	1.4	1.5	1.7	1.6	1.6	1.8	1.9	1.7	1.7	1.7	1.5
6	1.3	1.7	1.4	1.6	1.7	2.0	1.9	1.9	1.9	1.8	1.9	1.8	1.6
9	1.3	1.4	1.4	1.5	1.8	1.6	1.7	1.7	1.4	1.6	1.7	1.5	1.3

ATIFOLIA -- LATEWOOD PERCENTAGE

ANOVA results

for 0% of bole height, the ExD and LxE interactions were significant at the 5% level

for 10% of bole height, the latitude and diameter main effects were significant

for 20, 30, 40, 50, 60, 80 and 90% of bole height, the latitude means were significantly different at the 5% level

for 70% of bole height as well as for the lateral root, the LxE interaction was significant

for the stump, the latitude and elevation main effects were significant

for the tap root, the LxExD and ExD interactions were significant

NOTE: in the presence of interaction, inferences made about the main effects must be interpreted with caution

MURRAYANA -- LATEWOOD PERCENTAGE

ANOVA results : for 0% of bole height, the latitude means were significantly different at the 5% level

for 20% of bole height, the diameter means were significantly different

for 70% of bole height, the LxD interaction was significant

	LATITUDE			
	1	2	3	4
LOC				
0	13.56	21.11	16.22	17.78

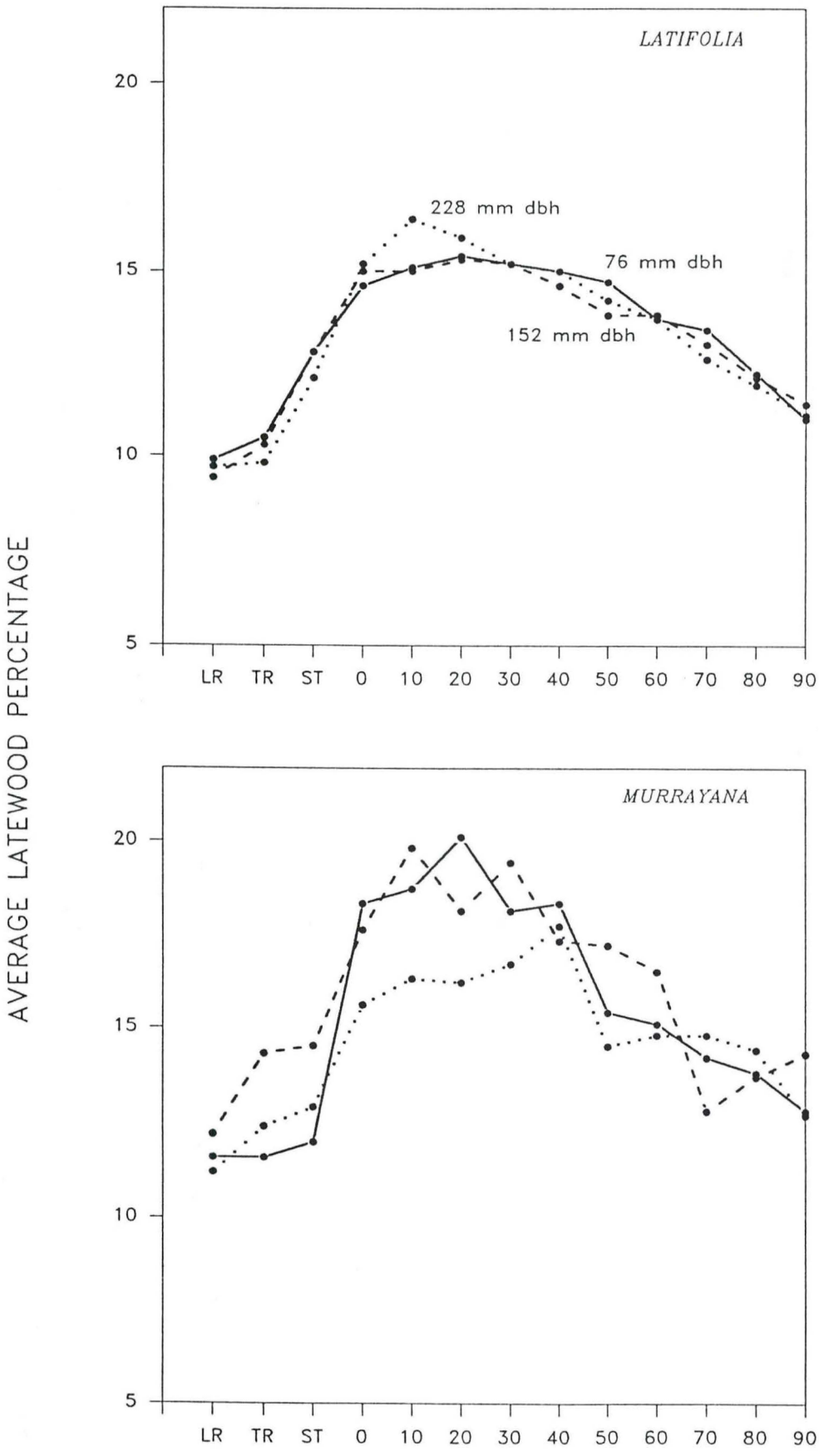
	DBH		
	1	2	3
LOC			
20	20.08	18.08	16.17

	ave	sd
10	18.28	4.79
30	18.06	3.91
40	17.78	5.06
50	15.69	3.71
60	15.47	3.51
80	13.94	3.28
90	13.25	3.72
stump	13.14	3.20
tap root	12.78	3.10
lateral root	11.64	3.03

		LATITUDE			
		1	2	3	4
	DBH				
	3	11.33	14.67	16.67	14.00
70%	6	9.33	13.67	13.33	15.00
	9	17.00	11.00	14.33	17.00

Figure 1a. Average latewood percentage vs. position in the tree for all three diameters of var. latifolia. Plotted points based on data found in Table 2.

Figure 1b. Average latewood percentage vs. position in tree for all three diameters of var. murrayana. Plotted points based on data found in Table 3.


LATIFOLIA
228 mm dbh
76 mm dbh
152 mm dbh
MURRAYANA
AVERAGE LATEWOOD PERCENTAGE
20
15
10
5
LR TR ST 0 10 20 30 40 50 60 70 80 90
LOCATION IN TREE

LATIFOLIA -- RESIN CANAL NUMBER (PER UNIT AREA)

ANOVA results

for 40% of bole height, the latitude and elevation main effects were significant at the 5% level

for 50% of bole height as well as for tap root, the latitude means were significantly different

for 90% of bole height, the LxExD interaction was significant

for the lateral root, the LxE interaction was significant

NOTE: in the presence of interaction, inferences made about the main effects must be interpreted with caution

MURRAYANA -- RESIN CANAL NUMBER (per unit area)

ANOVA results : for 0 and 70% of bole height, latitude means were significantly different at the 5% level

for 10% of bole height, the latitude and diameter main effects were significant

for 40% of bole height, the LxD interaction was significant

	LATITUDE			
	1	2	3	4
LOC				
0	40.44	26.22	36.00	31.56
10	39.56	30.67	38.89	31.89
70	36.22	29.78	39.00	39.78

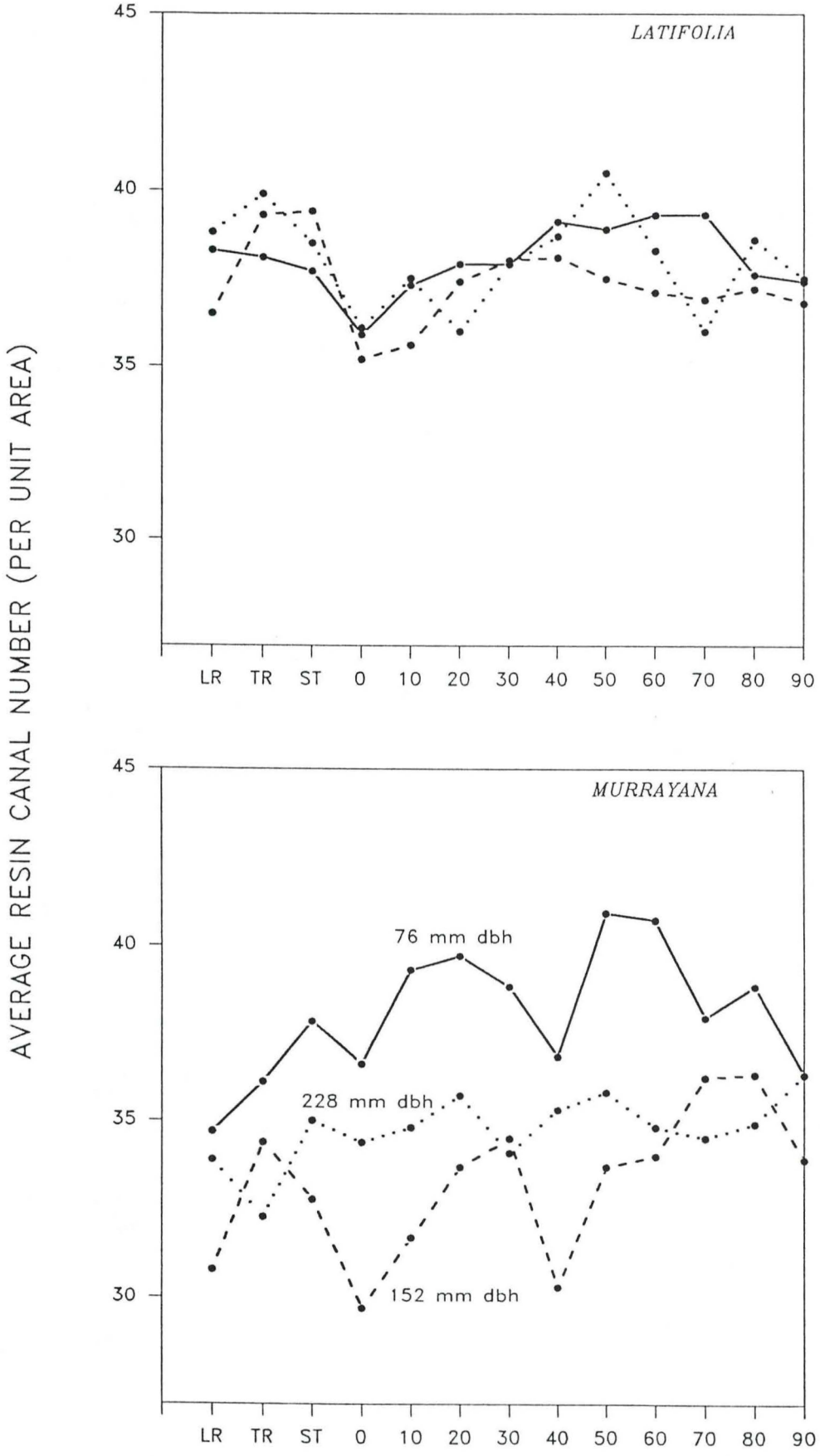
	DBH		
	1	2	3
LOC			
10	39.33	31.67	34.75

	ave	sd
20	36.33	7.22
30	35.81	7.38
50	36.81	8.45
60	36.50	8.26
80	36.67	6.99
90	35.50	7.84
stump	35.19	6.16
tap root	34.25	7.28
lateral root	33.14	7.24

		LATITUDE			
		1	2	3	4
	DBH				
	3	41.33	26.67	41.00	38.00
40%	6	33.33	21.33	38.00	28.67
	9	38.67	41.33	29.00	32.00

Figure 2a. Average resin canal number per unit area vs. position in the tree for all three diameters of var. latifolia. Plotted points based on data found in Table 2.

Figure 2b. Average resin canal number per unit area vs. position in tree for all three diameters of var. murrayana. Plotted points based on data found in Table 3.


LATIFOLIA
MURRAYANA
76 mm dbh
228 mm dbh
152 mm dbh
45
40
35
30
LR TR ST 0 10 20 30 40 50 60 70 80 90
AVERAGE RESIN CANAL NUMBER (PER UNIT AREA)
LOCATION IN TREE

LATIFOLIA -- RESIN CANAL DIAMETER

ANOVA results

for 80% of bole height, the latitude means were significantly different at the 5% level

for the tap root, the LxE interaction was significant

NOTE: in the presence of interaction, inferences made about the main effects must be interpreted with caution

MURRAYANA -- RESIN CANAL DIAMETER

ANOVA results : for 0, 40, 50, 80 and 90% of bole height as well as for tap root, the latitude means were significantly different at the 5% level

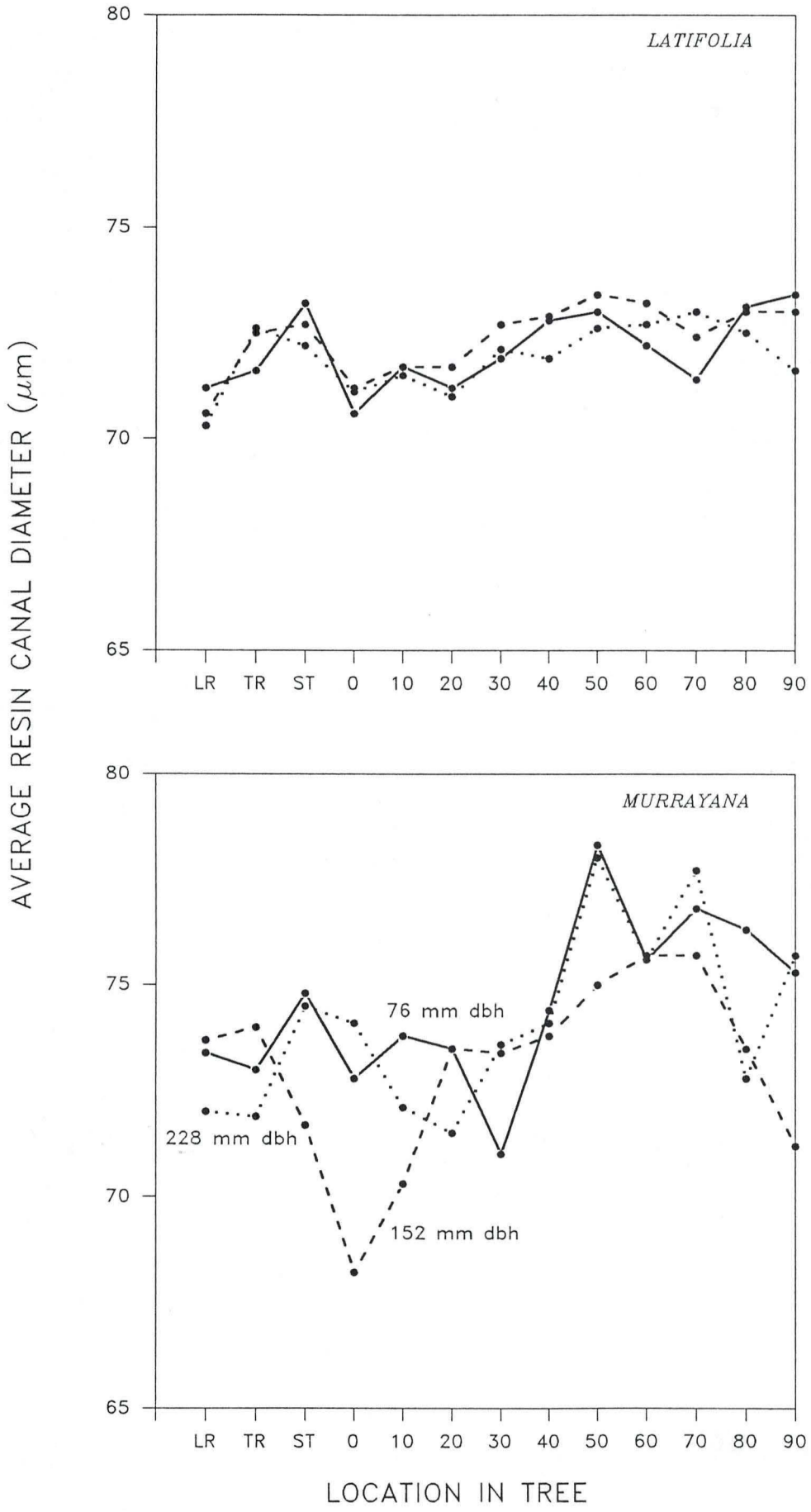
there were no other significant differences

	LATITUDE			
	1	2	3	4
LOC				
0	67.22	69.11	76.33	74.00
40	70.33	71.89	78.67	75.44
50	70.78	78.56	81.22	77.78
80	67.56	71.44	81.44	76.44
90	69.44	72.67	80.56	73.44
tap root	67.44	73.89	74.44	76.11

	ave	sd
10	72.03	8.58
20	72.83	8.01
30	72.67	8.06
60	75.61	8.12
70	76.72	7.10
stump	73.67	7.40
lateral root	73.03	5.23

Figure 3a. Average resin canal diameter vs. position in the tree for all three diameters of var. latifolia. Plotted points based on data found in Table 2.

Figure 3b. Average resin canal diameter vs. position in tree for all three diameters of var. murrayana. Plotted points based on data found in Table 3.


AVERAGE RESIN CANAL DIAMETER (μm)
80
75
70
65
LATIFOLIA
LR TR ST 0 10 20 30 40 50 60 70 80 90
MURRAYANA
76 mm dbh
228 mm dbh
152 mm dbh
LOCATION IN TREE

LATIFOLIA -- EARLYWOOD FIBER LENGTH

ANOVA results

for 0, 10, 20 and 30% of bole height, the LxE, LxD and ExD interactions were significant at the 5% level

for 40, 50 and 60% of bole height, the LxExD, LxE, LxD and ExD interactions were significant

for 70, 80 and 90% of bole height, the LxExD, LxE and LxD interactions were significant

for the stump, latitude means were significantly different at the 5% level

for the tap root, latitude means as well as the ExD interaction were significant

for the lateral root, the LxE interaction was significant

NOTE: in the presence of interaction, inferences made about the main effects must be interpreted with caution

MURRAYANA -- EARLYWOOD FIBER LENGTH

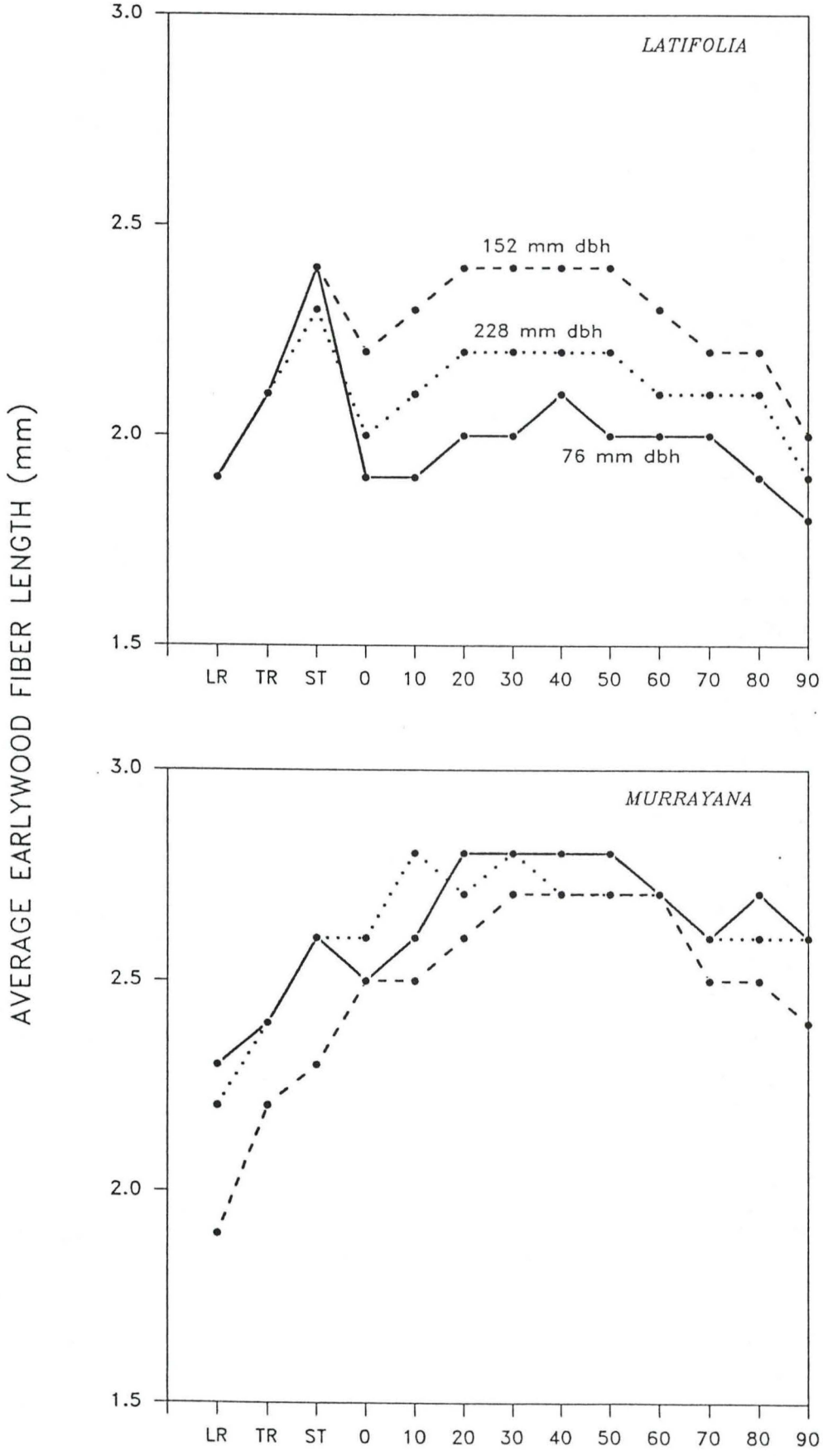
ANOVA results : for stump, there was a significant latitude by diameter interaction at the 5% level

	ave	sd
0	2.55	.38
10	2.65	.51
20	2.68	.57
30	2.74	.51
40	2.74	.47
50	2.76	.47
60	2.73	.44
70	2.60	.39
80	2.61	.40
90	2.55	.38
tap root	2.34	.42
lateral root	2.12	.47

		LATITUDE			
		1	2	3	4
	DBH				
	3	2.57	2.77	2.30	2.87
stump	6	2.70	1.87	2.73	1.93
	9	2.40	2.77	2.50	2.87

Figure 4a. Average earlywood fiber length vs. position in the tree for all three diameters of var. latifolia. Plotted points based on data found in Table 2.

Figure 4b. Average earlywood fiber length vs. position in tree for all three diameters of var. murrayana. Plotted points based on data found in Table 3.


LATIFOLIA
152 mm dbh
228 mm dbh
76 mm dbh
MURRAYANA
3.0
2.5
2.0
1.5
LR TR ST 0 10 20 30 40 50 60 70 80 90
AVERAGE EARLYWOOD FIBER LENGTH (mm)
LOCATION IN TREE

LATIFOLIA -- LATEWOOD FIBER LENGTH

ANOVA results

for 0, 10, 20, 30, 40 and 50% of bole height, the LxExD, LxE, LxD and ExD interactions were significant at the 5% level

for 60, 70, 80 and 90% of bole height, the LxExD, LxE and LxD interactions were significant

for the stump, the LxExD interaction was significant

for the tap and lateral roots, the latitude means were significantly different at the 5% level

NOTE: in the presence of interaction, inferences made about the main effects must be interpreted with caution

MURRAYANA -- LATEWOOD FIBER LENGTH

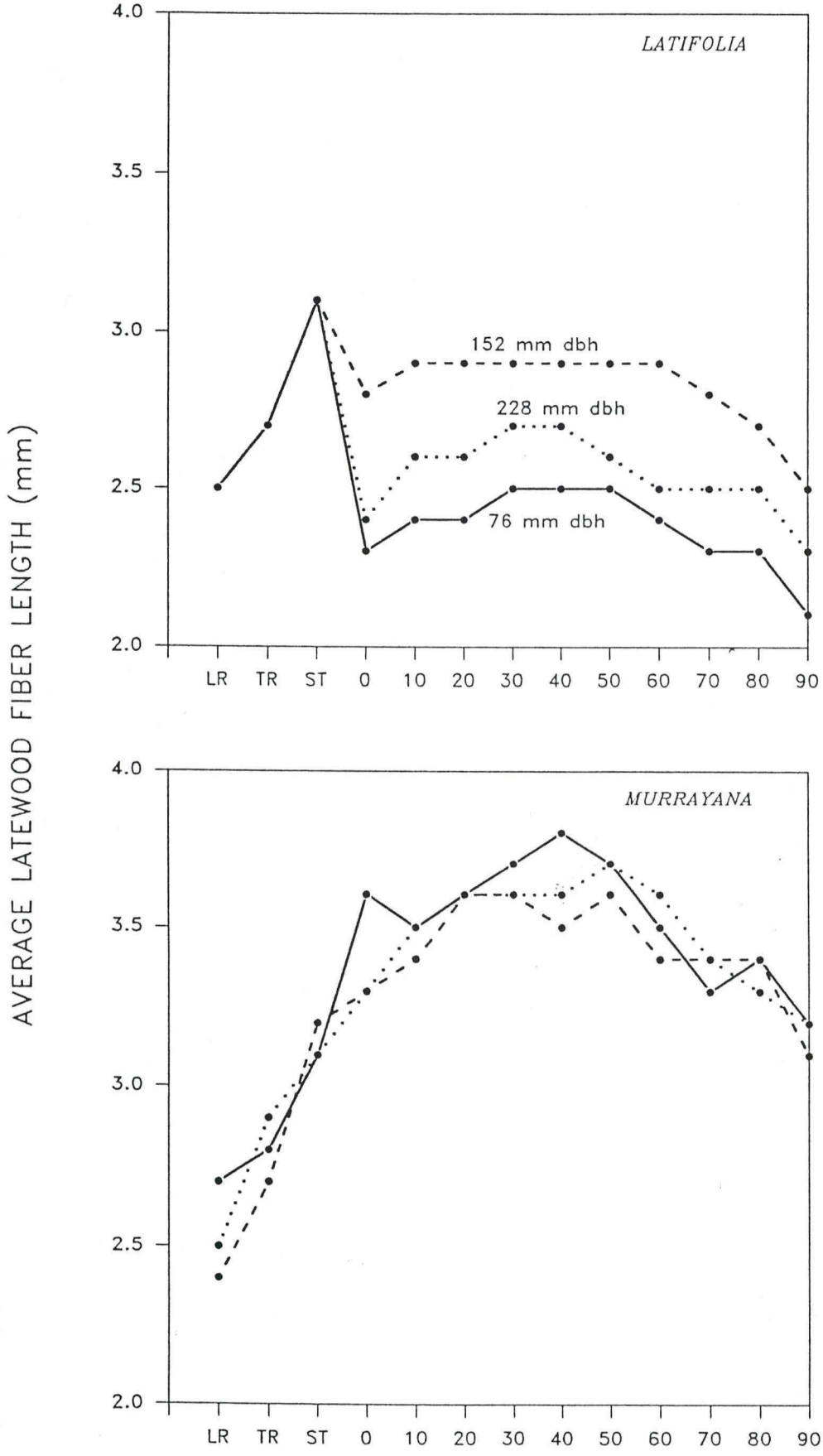
ANOVA results : for 0% of bole height, latitude means were significantly different at the 5% level

	ave	sd
10	3.49	.56
20	3.59	.46
30	3.64	.50
40	3.63	.52
50	3.68	.50
60	3.48	.51
70	3.38	.50
80	3.33	.49
90	3.15	.45
stump	3.14	.50
tap root	2.78	.44
lateral root	2.54	.46

	LATITUDE			
	1	2	3	4
LOC				
0	3.56	3.70	3.38	2.99

Figure 5a. Average latewood fiber length vs. position in the tree for all three diameters of var. latifolia. Plotted points based on data found in Table 2.

Figure 5b. Average latewood fiber length vs. position in tree for all three diameters of var. murrayana. Plotted points based on data found in Table 3.


LATIFOLIA
152 mm dbh
228 mm dbh
76 mm dbh
MURRAYANA
4.0
3.5
3.0
2.5
2.0
LR TR ST 0 10 20 30 40 50 60 70 80 90
AVERAGE LATEWOOD FIBER LENGTH (mm)
LOCATION IN TREE

LATIFOLIA -- EARLYWOOD MICROFIBRIL ANGLE

ANOVA results
---

for 0% of bole height, the LxE interaction was significant at the 5% level

for 10 and 20% of bole height, diameter means as well as the LxE interaction were significant

for 30 and 90% of bole height, the LxExD, LxE and LxD interactions were significant

for 40, 60 and 70% of bole height, the LxExD and LxE interactions were significant

for 50% of bole height, the LxExD, ExD and LxE interactions were significant

for 80% of bole height, the significant interactions were LxD and LxE

for the stump and the lateral root, the latitude means were significantly different at the 5% level

for the tap root, the latitude main effect as well as the ExD interaction were significant

NOTE: in the presence of interaction, inferences made about the main effects must be interpreted with caution

MURRAYANA -- EARLYWOOD MICROFIBRIL ANGLE

ANOVA results : for 0 - 90% of bole height, latitude means were significantly different at the 5% level

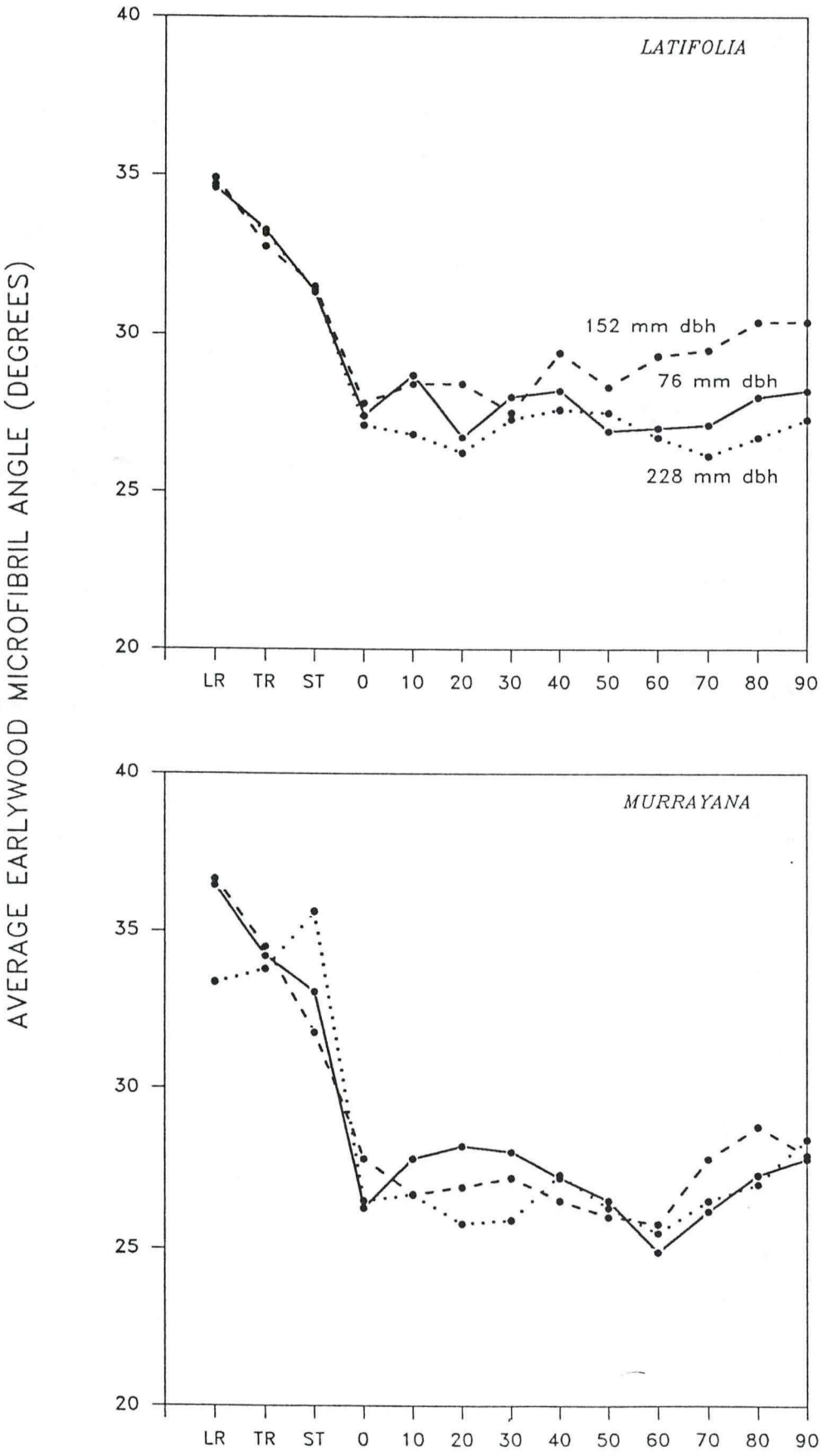
for stump, tap root and lateral root there were no significant differences

	LATITUDE			
	1	2	3	4
LOC	-----	-----	-----	-----
0	22.22	30.33	24.89	29.89
10	23.56	28.56	24.78	31.22
20	22.44	31.44	24.00	30.00
30	22.33	30.78	24.22	30.78
40	23.00	32.56	24.56	27.89
50	23.00	28.78	24.56	28.78
60	22.00	29.44	23.33	26.78
70	22.78	31.11	25.00	28.33
80	22.22	32.33	26.33	29.89
90	22.44	32.56	27.22	29.89

	ave	sd
	-----	----
stump	33.47	5.51
tap root	34.17	4.62
lateral root	35.47	4.15

Figure 6a. Average earlywood microfibril angle vs. position in the tree for all three diameters of var. latifolia. Plotted points based on data found in Table 2.

Figure 6b. Average earlywood microfibril angle vs. position in tree for all three diameters of var. murrayana. Plotted points based on data found in Table 3.


AVERAGE EARLYWOOD MICROFIBRIL ANGLE (DEGREES)
LATIFOLIA
152 mm dbh
76 mm dbh
228 mm dbh
MURRAYANA
40
35
30
25
20
LR TR ST 0 10 20 30 40 50 60 70 80 90
LOCATION IN TREE

LATIFOLIA -- LATEWOOD MICROFIBRIL ANGLE

ANOVA results

for 0, 10, 20, 40 and 80% of bole height, the LxE interaction was significant at the 5% level

for 30, 50, 60 and 70% of bole height, the LxExD and LxE interactions were significant

for 90% of bole height, the LxExD, LxD, ExD and LxE interactions were significant

for the stump, the LxD interaction was significant

for the tap root, the latitude main effect and the ExD interaction were significant

for the lateral root, the latitude means were significantly different

NOTE: in the presence of interaction, inferences made about the main effects must be interpreted with caution

MURRAYANA -- LATEWOOD MICROFIBRIL ANGLE

ANOVA results : for 0 - 90% of bole height, latitude means were significantly different at the 5% level

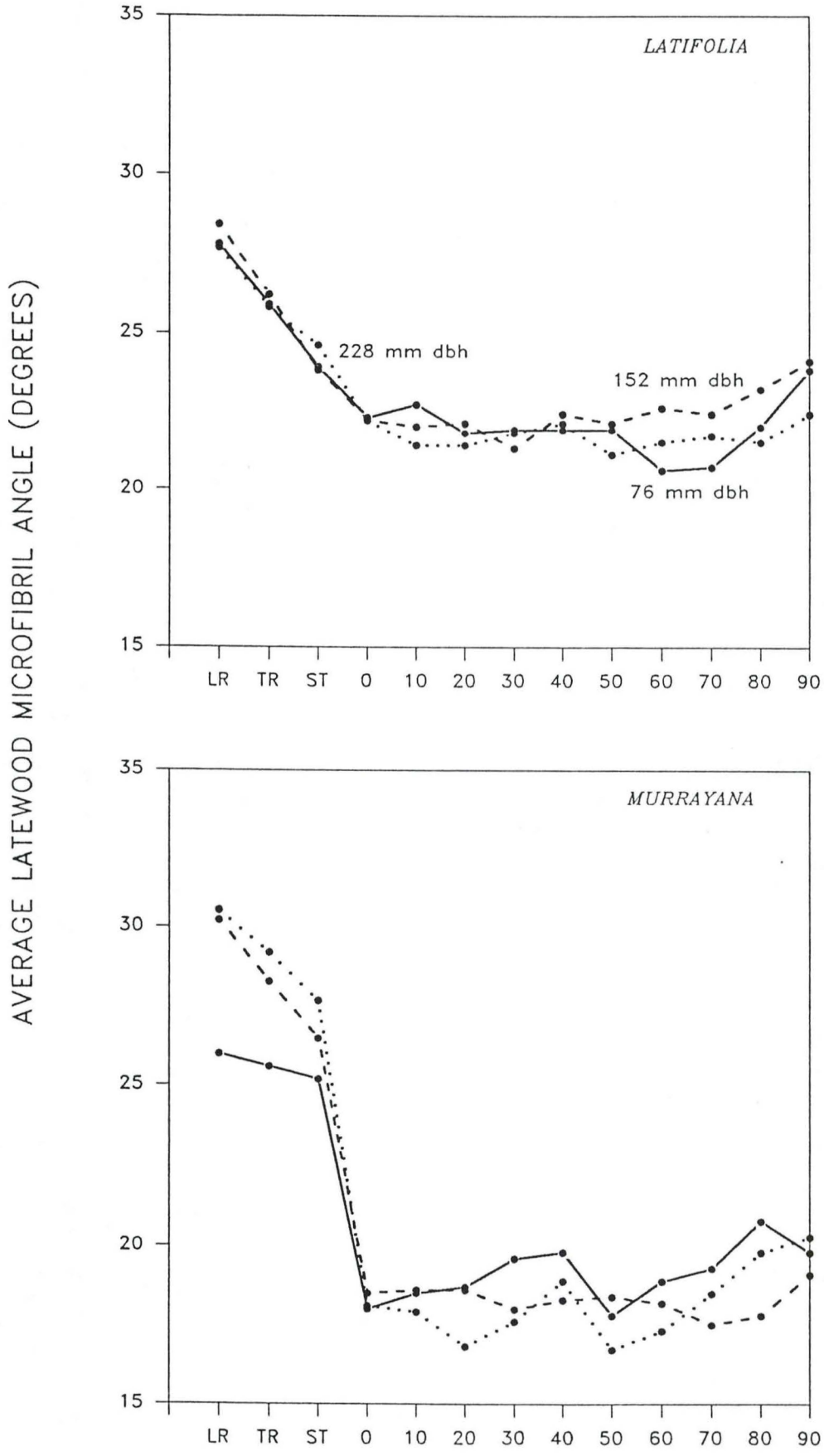
for stump, tap root and lateral root, there were no significant differences

	LATITUDE			
	1	2	3	4
LOC				
0	12.22	18.56	18.11	23.89
10	12.78	19.56	17.78	23.22
20	12.78	19.22	16.44	23.67
30	12.78	20.44	18.00	22.33
40	12.11	22.78	18.22	22.89
50	12.67	19.67	16.00	22.11
60	13.22	18.89	17.44	22.89
70	12.89	19.22	19.44	22.11
80	12.44	21.78	19.22	24.33
90	12.44	21.89	20.56	24.00

	ave	sd
stump	26.44	4.94
tap root	27.69	4.04
lateral root	28.89	5.04

Figure 7a. Average latewood microfibril angle vs. position in the tree for all three diameters of var. latifolia. Plotted points based on data found in Table 2.

Figure 7b. Average latewood microfibril angle vs. position in tree for all three diameters of var. murrayana. Plotted points based on data found in Table 3.


AVERAGE LATEWOOD MICROFIBRIL ANGLE (DEGREES)
LATIFOLIA
228 mm dbh
152 mm dbh
76 mm dbh
MURRAYANA
35
30
25
20
15
LR
TR
ST
0
10
20
30
40
50
60
70
80
90
LOCATION IN TREE

LATIFOLIA -- EARLYWOOD TANGENTIAL CELL DIAMETER

ANOVA results

for 0% of bole height as well as for tap root and lateral root, the latitude means were significantly different at the 5% level

for 60% of bole height, the ExD interaction was significant

for 80% of bole height, the diameter means differed significantly at the 5% level

NOTE: in the presence of interaction, inferences made about the main effects must be interpreted with caution

MURRAYANA -- EARLYWOOD TANGENTIAL CELL DIAMETER

ANOVA results : for 0, 10, 20, 30 and 90% of bole height as well as for lateral root, the latitude means were significantly different at the 5% level

for the stump and tap root, the LxD interaction was significant

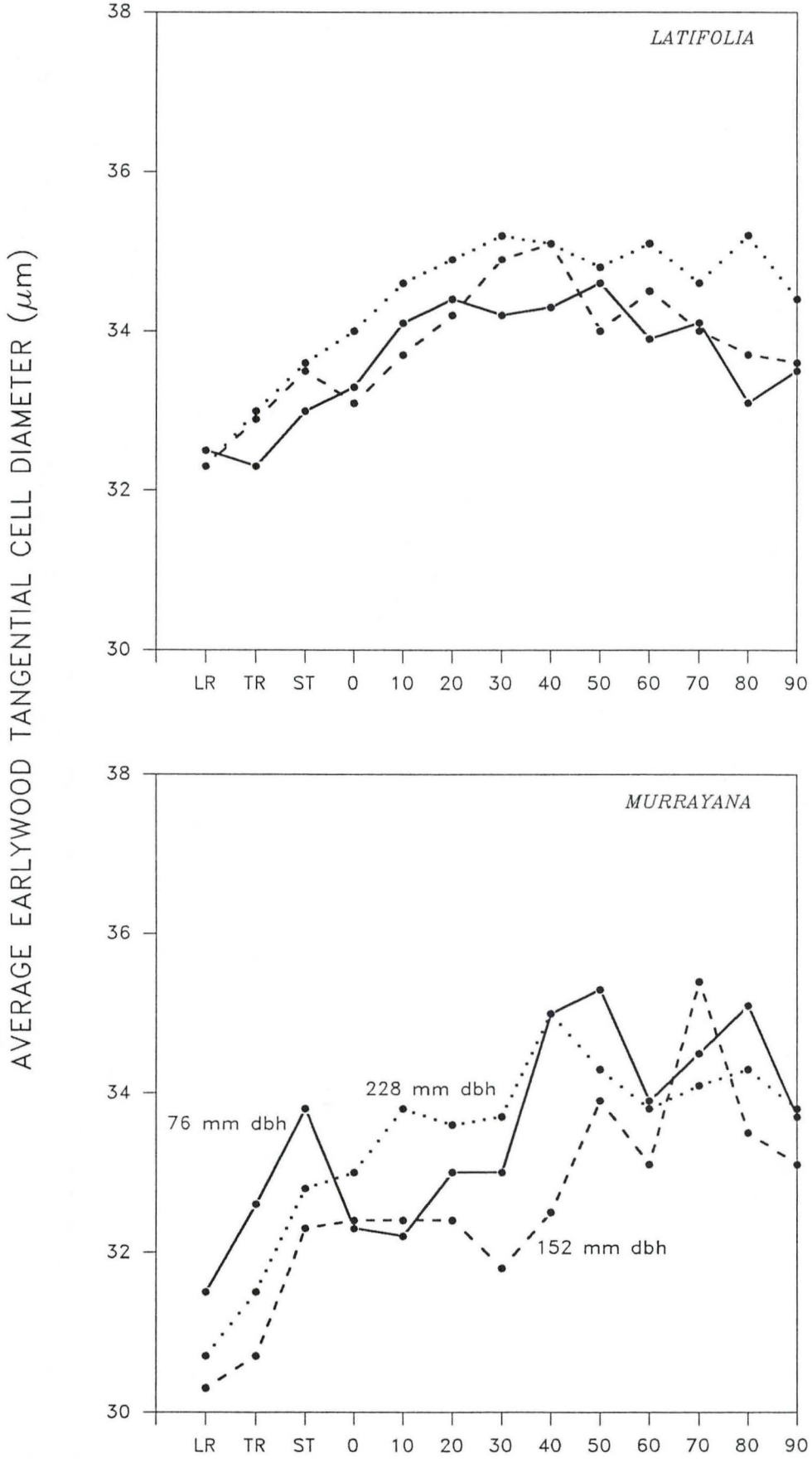
		LATITUDE			
		1	2	3	4
	LOC				
	0	34.33	35.11	28.78	32.00
	10	35.33	33.89	28.33	33.56
	20	36.78	34.00	27.33	33.89
	30	34.56	36.33	29.33	31.11
	90	33.33	35.78	28.89	36.11
lateral	root	29.33	33.56	28.00	32.33

	ave	sd
40	34.17	4.56
50	34.50	4.80
60	33.61	4.58
70	34.67	4.68
80	34.31	5.37

		LATITUDE			
		1	2	3	4
	DBH				
stump	3	32.33	30.00	31.00	42.00
	6	29.33	41.00	27.00	31.67
	9	34.67	34.00	31.33	31.33
tap root	3	31.33	31.00	30.00	38.00
	6	29.00	39.00	25.33	29.33
	9	35.00	34.33	27.67	29.00

Figure 8a. Average earlywood tangential cell diameter vs. position in the tree for all three diameters of var. latifolia. Plotted points based on data found in Table 2.

Figure 8b. Average earlywood tangential cell diameter vs. position in tree for all three diameters of var. murrayana. Plotted points based on data found in Table 3.


AVERAGE EARLYWOOD TANGENTIAL CELL DIAMETER (μm)
LATIFOLIA
MURRAYANA
76 mm dbh
228 mm dbh
152 mm dbh
38
36
34
32
30
LR TR ST 0 10 20 30 40 50 60 70 80 90
LOCATION IN TREE

LATIFOLIA -- LATEWOOD TANGENTIAL CELL DIAMETER

ANOVA results

for 0 and 70% of bole height as well as for the stump and tap root, latitude means were significantly different at the 5% level

for 80% of bole height, the LxExD interaction was significant

for the lateral root, the LxExD and LxE interactions were significant

NOTE: in the presence of interaction, inferences made about the main effects must be interpreted with caution

MURRAYANA -- LATEWOOD TANGENTIAL CELL DIAMETER

ANOVA results : for 30, 50, 80 and 90% of bole height, latitude means differed significantly at the 5% level

for stump, there was a significant latitude by diameter interaction

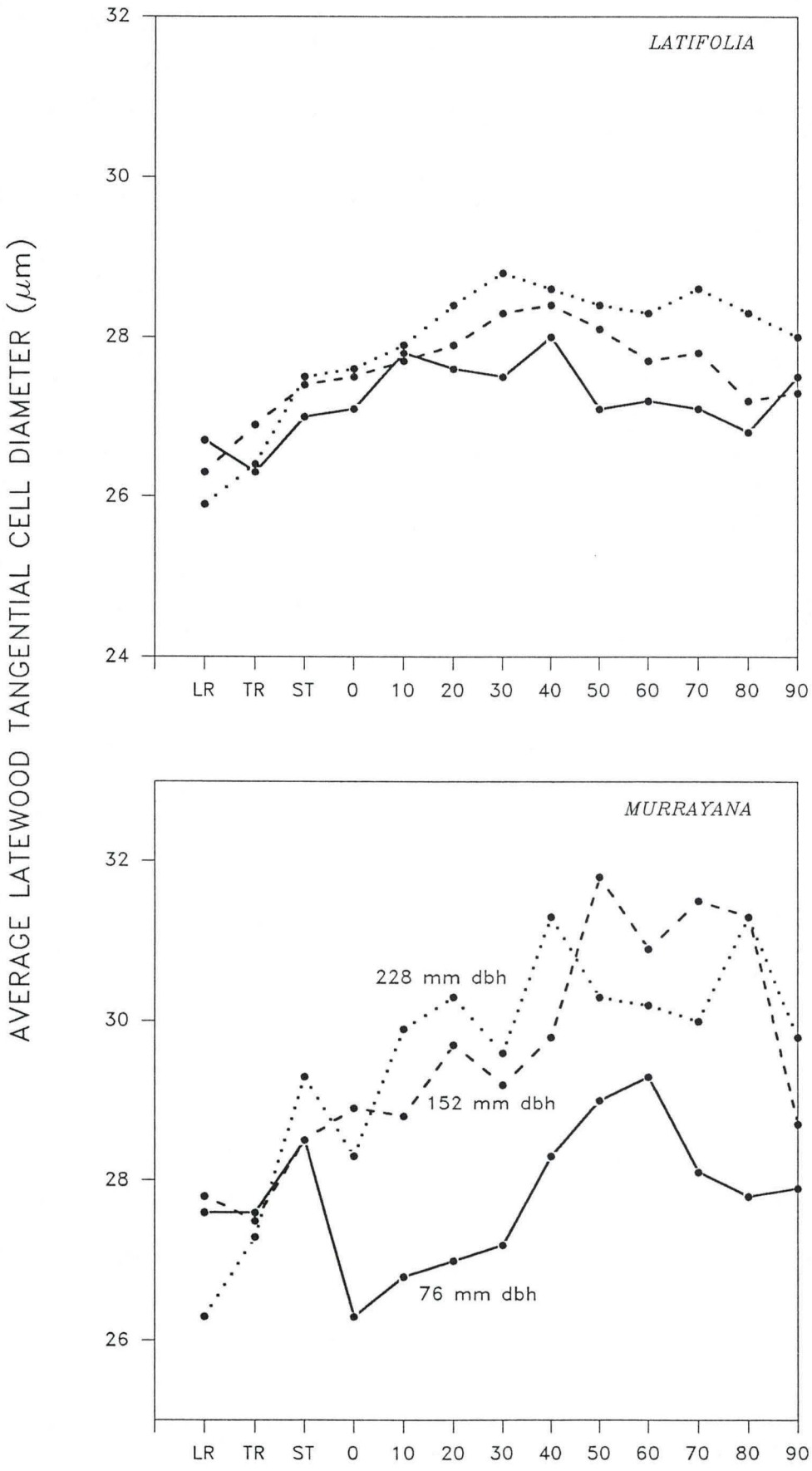
	LATITUDE			
	1	2	3	4
LOC				
30	27.67	32.11	28.67	26.11
50	28.22	33.89	30.22	29.11
80	27.89	33.44	30.67	28.44
90	25.89	32.11	27.56	29.56

	ave	sd
0	27.83	4.25
10	28.47	3.70
20	28.97	3.90
40	29.81	3.88
60	30.14	4.66
70	29.86	4.36
tap root	27.47	4.65
lateral root	27.22	4.44

		LATITUDE			
		1	2	3	4
	DBH				
	3	25.33	27.00	30.67	31.00
stump	6	22.00	37.00	26.33	28.67
	9	30.33	30.67	29.00	27.33

Figure 9a. Average latewood tangential cell diameter vs. position in the tree for all three diameters of var. latifolia. Plotted points based on data found in Table 2.

Figure 9b. Average latewood tangential cell diameter vs. position in tree for all three diameters of var. murrayana. Plotted points based on data found in Table 3.


LATIFOLIA
MURRAYANA
228 mm dbh
152 mm dbh
76 mm dbh
32
30
28
26
24
LR TR ST 0 10 20 30 40 50 60 70 80 90
AVERAGE LATEWOOD TANGENTIAL CELL DIAMETER (μm)
LOCATION IN TREE

LATIFOLIA -- EARLYWOOD TANGENTIAL LUMEN DIAMETER

ANOVA results

for 0% of bole height as well as for tap root and lateral root, the latitude means were significantly different at the 5% level

for 60% of bole height, the ExD interaction was significant

for 80% of bole height, the diameter means differed significantly at the 5% level

for 90% of bole height, the LxE interaction was significant

NOTE: in the presence of interaction, inferences made about the main effects must be interpreted with caution

MURRAYANA -- EARLYWOOD TANGENTIAL LUMEN DIAMETER

ANOVA results : for 10, 20, 30 and 90% of bole height, as well as for lateral root, latitude means differed significantly at the 5% level

for the stump, tap root and lateral root, the LxD interaction was significant

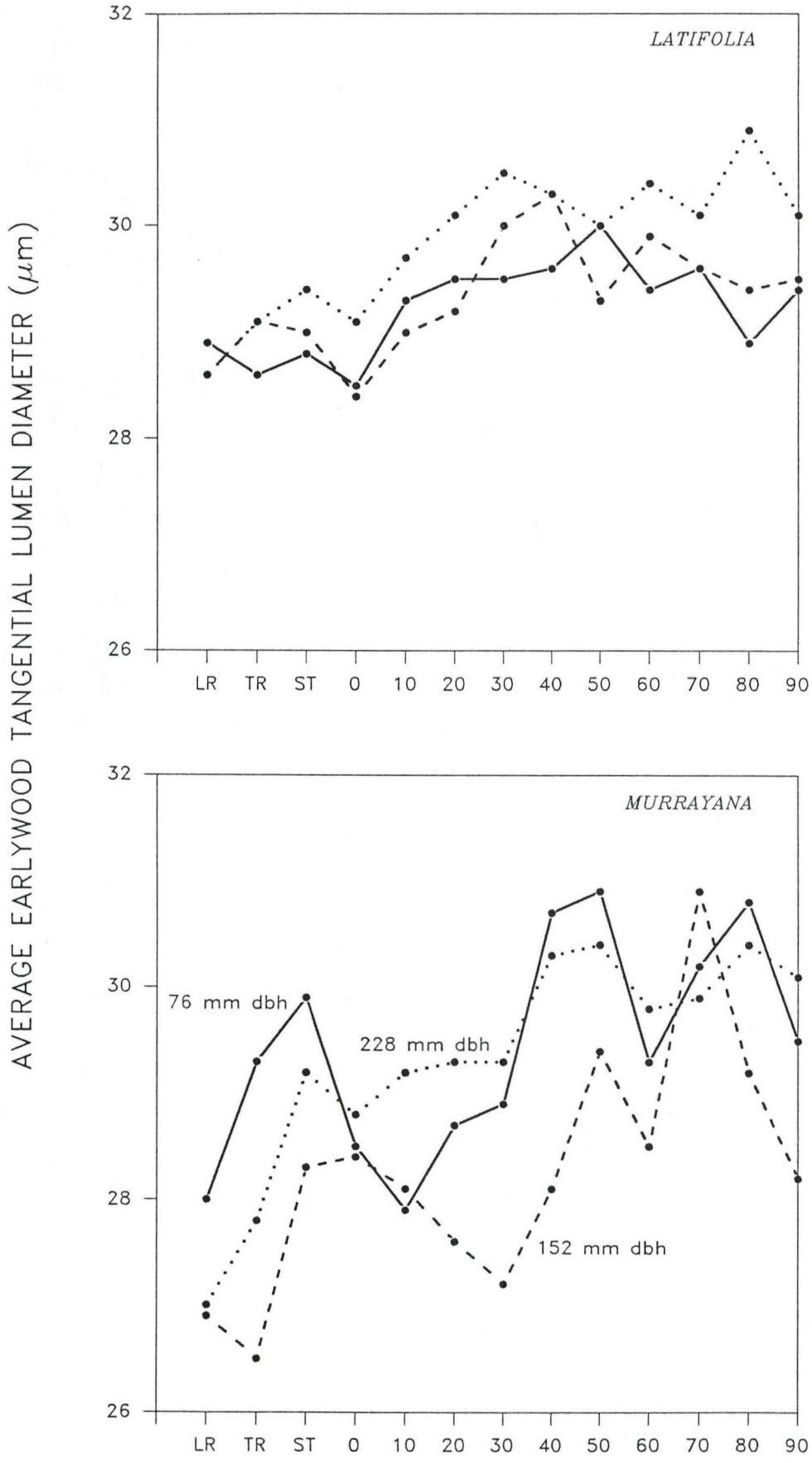
		LATITUDE			
		1	2	3	4
	LOC				
	10	30.67	29.33	24.11	29.44
	20	32.00	28.89	23.67	29.56
	30	29.78	31.56	25.33	27.11
	90	28.22	31.33	25.22	32.22
lateral	root	25.78	30.11	24.56	28.78

	ave	sd
0	28.58	4.90
40	29.69	4.52
50	30.25	4.71
60	29.19	4.60
70	30.33	4.81
80	30.11	5.46

		LATITUDE			
		1	2	3	4
	DBH				
stump	3	28.00	26.33	28.00	37.33
	6	25.00	37.33	22.33	28.33
	9	31.33	30.67	27.00	27.67
tap root	3	27.67	27.67	27.33	34.67
	6	25.00	34.67	20.33	26.00
	9	31.33	31.00	24.00	25.00

Figure 10a. Average earlywood tangential lumen diameter vs. position in the tree for all three diameters of var. latifolia. Plotted points based on data found in Table 2.

Figure 10b. Average earlywood tangential lumen diameter vs. position in tree for all three diameters of var. murrayana. Plotted points based on data found in Table 3.


LATIFOLIA
MURRAYANA
76 mm dbh
228 mm dbh
152 mm dbh
32
30
28
26
LR TR ST 0 10 20 30 40 50 60 70 80 90
AVERAGE EARLYWOOD TANGENTIAL LUMEN DIAMETER (μm)
LOCATION IN TREE

LATIFOLIA -- LATEWOOD TANGENTIAL LUMEN DIAMETER

ANOVA results

for 10, 60 and 80% of bole height as well as for lateral root, the LxExD interaction was significant at the 5% level

for the stump, the latitude means were significantly different

for the tap root, the LxExD and LxE interactions were significant

NOTE: in the presence of interaction, inferences made about the main effects must be interpreted with caution

MURRAYANA -- LATEWOOD TANGENTIAL LUMEN DIAMETER

ANOVA results : for 30, 50, 80 and 90% of bole height, as well as for tap root and lateral root, the latitude means were significantly different at the 5% level

for stump, there was a significant latitude by diameter interaction

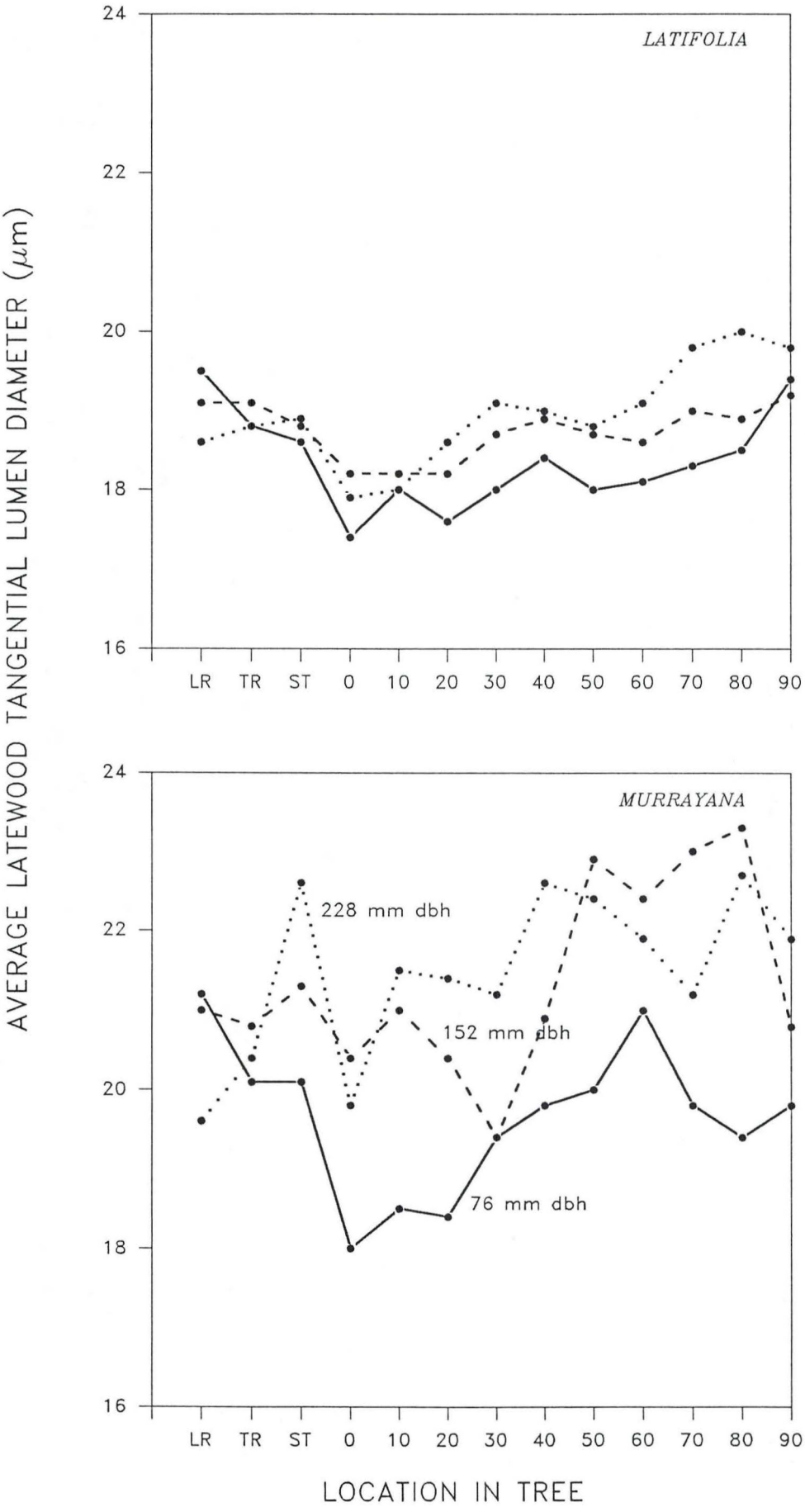
	LATITUDE			
LOC	1	2	3	4
30	18.11	23.44	20.44	18.00
50	19.22	24.78	22.56	20.56
80	18.11	25.33	23.11	20.56
90	17.56	23.89	20.22	21.78
tap root	19.22	24.33	19.89	18.22
lateral root	17.44	23.22	20.44	21.22

	ave	sd
0	19.42	4.37
10	20.33	3.95
20	20.08	4.21
40	21.11	3.76
60	21.78	5.03
70	21.31	4.74

		LATITUDE			
	DBH	1	2	3	4
	3	17.00	19.67	24.67	19.00
stump	6	13.33	30.33	19.67	21.67
	9	24.00	24.00	21.67	20.67

Figure 11a. Average latewood tangential lumen diameter vs. position in the tree for all three diameters of var. latifolia. Plotted points based on data found in Table 2.

Figure 11b. Average latewood tangential lumen diameter vs. position in tree for all three diameters of var. murrayana. Plotted points based on data found in Table 3.


AVERAGE LATEWOOD TANGENTIAL LUMEN DIAMETER (μm)
LATIFOLIA
MURRAYANA
228 mm dbh
152 mm dbh
76 mm dbh
24
22
20
18
16
LR TR ST 0 10 20 30 40 50 60 70 80 90
LOCATION IN TREE

LATIFOLIA -- EARLYWOOD RADIAL CELL DIAMETER

ANOVA results

for 0, 10 and 20% of bole height, the latitude means were significantly different at the 5% level

for 50% of bole height, the LxExD interaction was significant

for 60 and 80% of bole height, the ExD interaction was significant

for 90% of bole height, the diameter main effect and the LxE interaction were significant

for the stump, the diameter means were significantly different

for the tap root, the LxExD, LxE and ExD interactions were significant

for the lateral root, the LxExD and LxE interactions were significant

NOTE: in the presence of interaction, inferences made about the main effects must be interpreted with caution

MURRAYANA -- EARLYWOOD RADIAL CELL DIAMETER

ANOVA results : for 0-60% and 80-90% of bole height, the latitude means were significantly different at the 5% level

for the stump, tap root and lateral root, the LxD interaction was significant

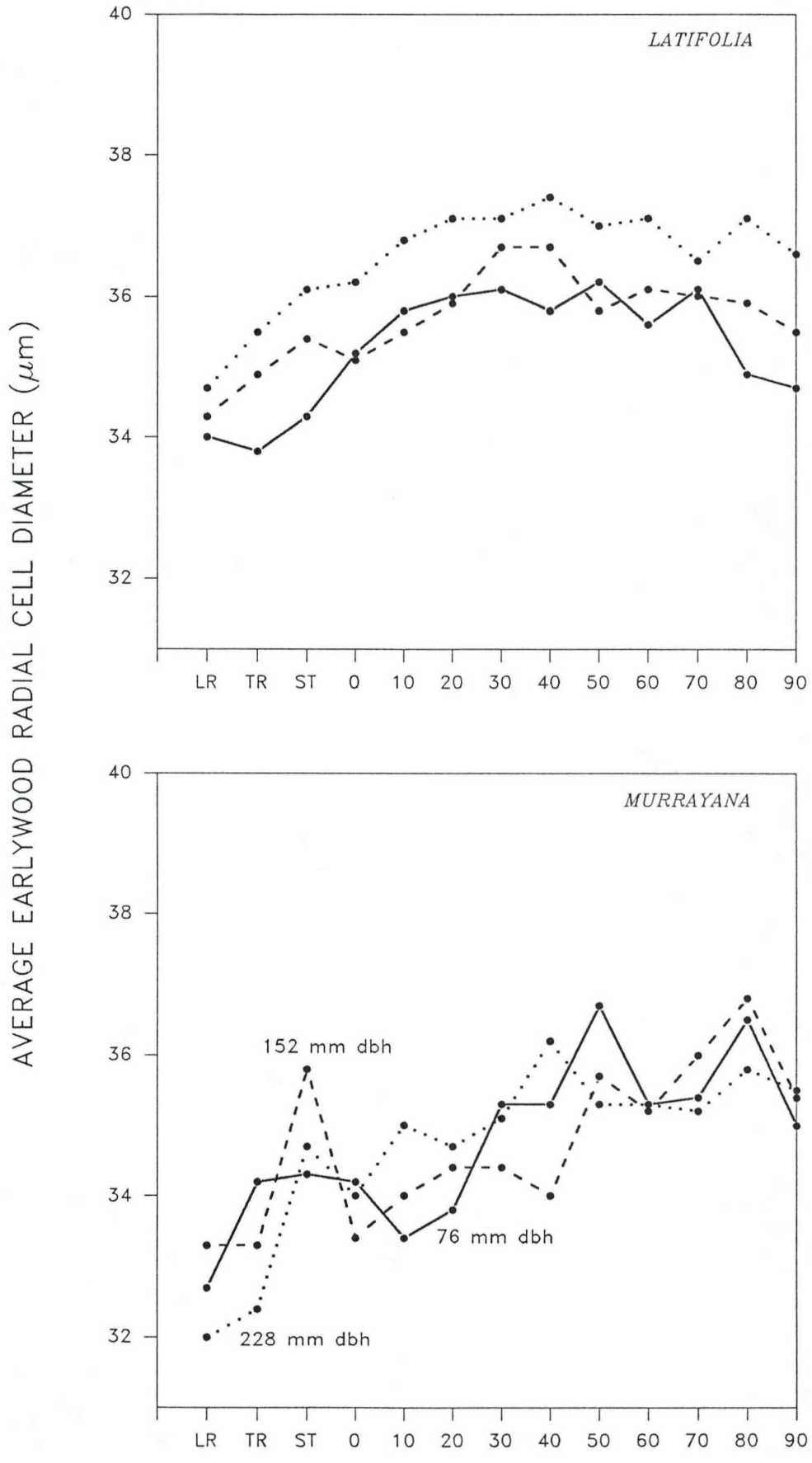
	LATITUDE			
	1	2	3	4
LOC				
0	35.56	38.00	30.44	31.44
10	37.00	37.11	29.78	32.67
20	37.89	36.11	30.00	33.22
30	37.78	39.44	31.44	31.11
40	37.56	38.11	32.33	32.56
50	36.67	39.44	34.00	33.44
60	35.67	39.56	33.56	32.22
80	35.00	41.22	35.22	33.89
90	35.44	39.33	32.00	34.44

	ave	sd
70	35.53	4.72

		LATITUDE			
		1	2	3	4
	DBH				
stump	3	33.00	32.00	29.33	42.67
	6	34.33	46.67	30.67	31.33
	9	36.33	39.33	34.00	29.00
tap root	3	33.67	34.00	29.33	39.67
	6	33.00	42.00	28.33	30.00
	9	35.67	37.00	30.67	26.33
teral root	3	30.00	32.00	30.33	38.33
	6	32.00	40.33	31.67	29.00
	9	32.67	37.33	30.33	27.67

Figure 12a. Average earlywood radial cell diameter vs. position in the tree for all three diameters of var. latifolia. Plotted points based on data found in Table 2.

Figure 12b. Average earlywood radial cell diameter vs. position in tree for all three diameters of var. murrayana. Plotted points based on data found in Table 3.


LATIFOLIA
MURRAYANA
152 mm dbh
76 mm dbh
228 mm dbh
40
38
36
34
32
LR TR ST 0 10 20 30 40 50 60 70 80 90
AVERAGE EARLYWOOD RADIAL CELL DIAMETER (μm)
LOCATION IN TREE

LATIFOLIA -- LATEWOOD RADIAL CELL DIAMETER

ANOVA results

for 0, 20, 30, 40, 50 and 90% of bole height as well as for the stump and tap root, the latitude means were significantly different at the 5% level

for 10% of bole height as well as for the lateral root, the latitude main effect and the ExD interaction were significant

for 60 and 80% of bole height, the LxExD interaction was significant

for 70% of bole height, the LxE and LxExD interactions were significant

NOTE: in the presence of interaction, inferences made about the main effects must be interpreted with caution

MURRAYANA -- LATEWOOD RADIAL CELL DIAMETER

ANOVA results : for 0, 30, 40, 50, 70, 80 and 90% of bole height, latitude means were significantly different at the 5% level

for stump, there was a significant latitude by diameter interaction

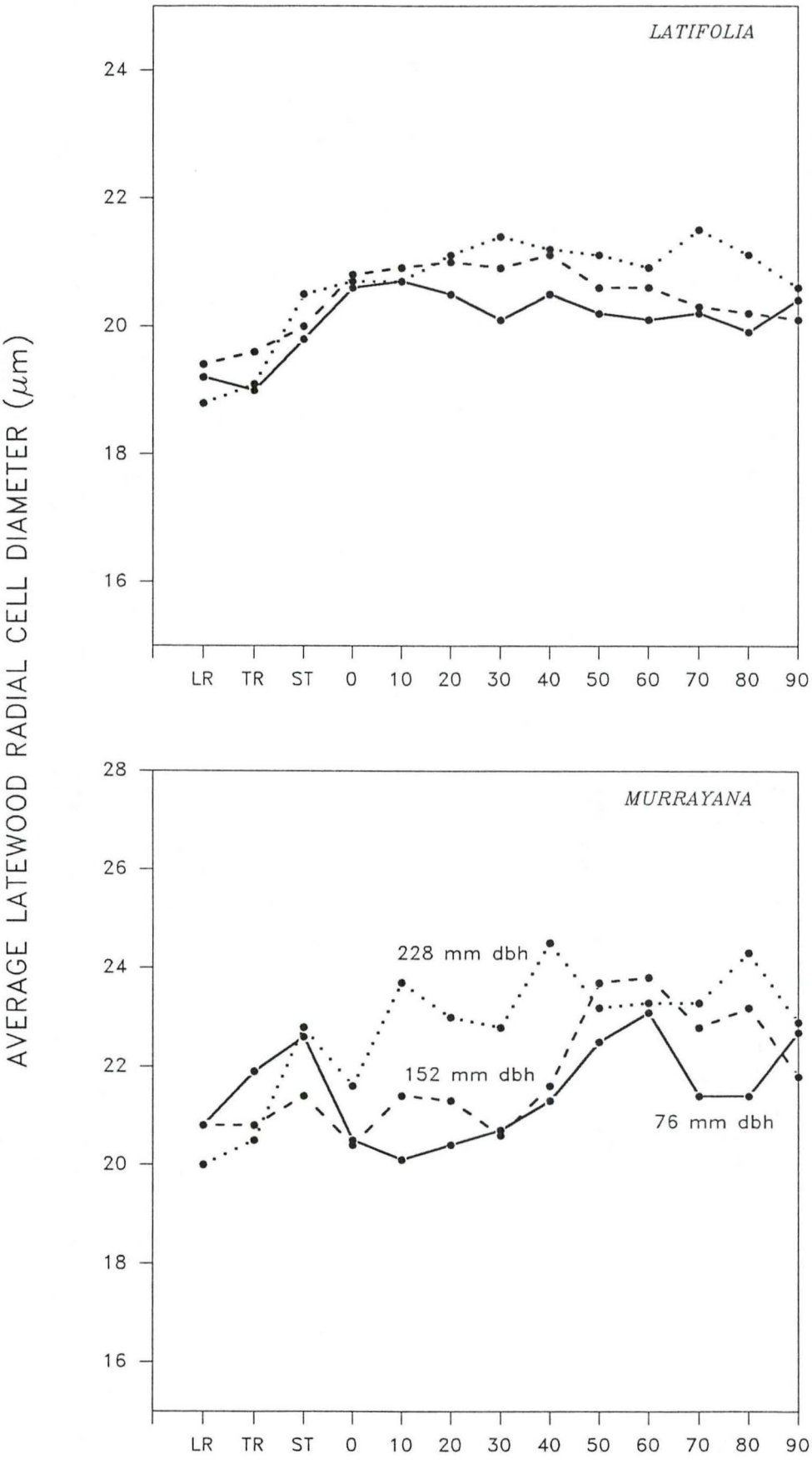
	LATITUDE			
	1	2	3	4
LOC				
0	21.00	23.44	21.33	17.56
30	20.22	24.67	22.11	18.44
40	21.22	25.00	23.67	20.00
50	22.78	26.44	22.78	20.44
70	20.22	24.89	24.33	20.56
80	21.11	26.56	24.11	20.11
90	20.22	26.00	22.00	21.56

	ave	sd
10	21.72	4.02
20	21.56	4.18
60	23.36	4.26
tap root	21.08	5.09
lateral root	20.53	4.77

		LATITUDE			
		1	2	3	4
	DBH				
	3	20.33	20.67	24.33	25.00
stump	6	15.67	29.33	22.67	18.00
	9	23.67	23.33	22.67	21.33

Figure 13a. Average latewood radial cell diameter vs. position in the tree for all three diameters of var. latifolia. Plotted points based on data found in Table 2.

Figure 13b. Average latewood radial cell diameter vs. position in tree for all three diameters of var. murrayana. Plotted points based on data found in Table 3.


LATIFOLIA
MURRAYANA
228 mm dbh
152 mm dbh
76 mm dbh
AVERAGE LATEWOOD RADIAL CELL DIAMETER (μm)
LOCATION IN TREE
LR TR ST 0 10 20 30 40 50 60 70 80 90
16 18 20 22 24
16 18 20 22 24 26 28

LATIFOLIA -- EARLYWOOD RADIAL LUMEN DIAMETER

ANOVA results

for 0 and 10% of bole height, the latitude means differed significantly at the 5% level

for 40% of bole height, the diameter means were significantly different

for 60, 70 and 80% of bole height, the ExD interaction was significant

for 90% of bole height, the diameter main effect and the LxE interaction were significant

for the stump, the LxD interaction was significant

for the tap root, the LxExD, LxE and ExD interactions were significant

for the lateral root, the LxExD and LxE interactions were significant

NOTE: in the presence of interaction, inferences made about the main effects must be interpreted with caution

MURRAYANA -- EARLYWOOD RADIAL LUMEN DIAMETER

ANOVA results : for 0-60% and 80% of bole height as well as for tap root, the latitude means differed significantly at the 5% level

for 90% of bole height, stump and lateral root, the LxD interaction was significant

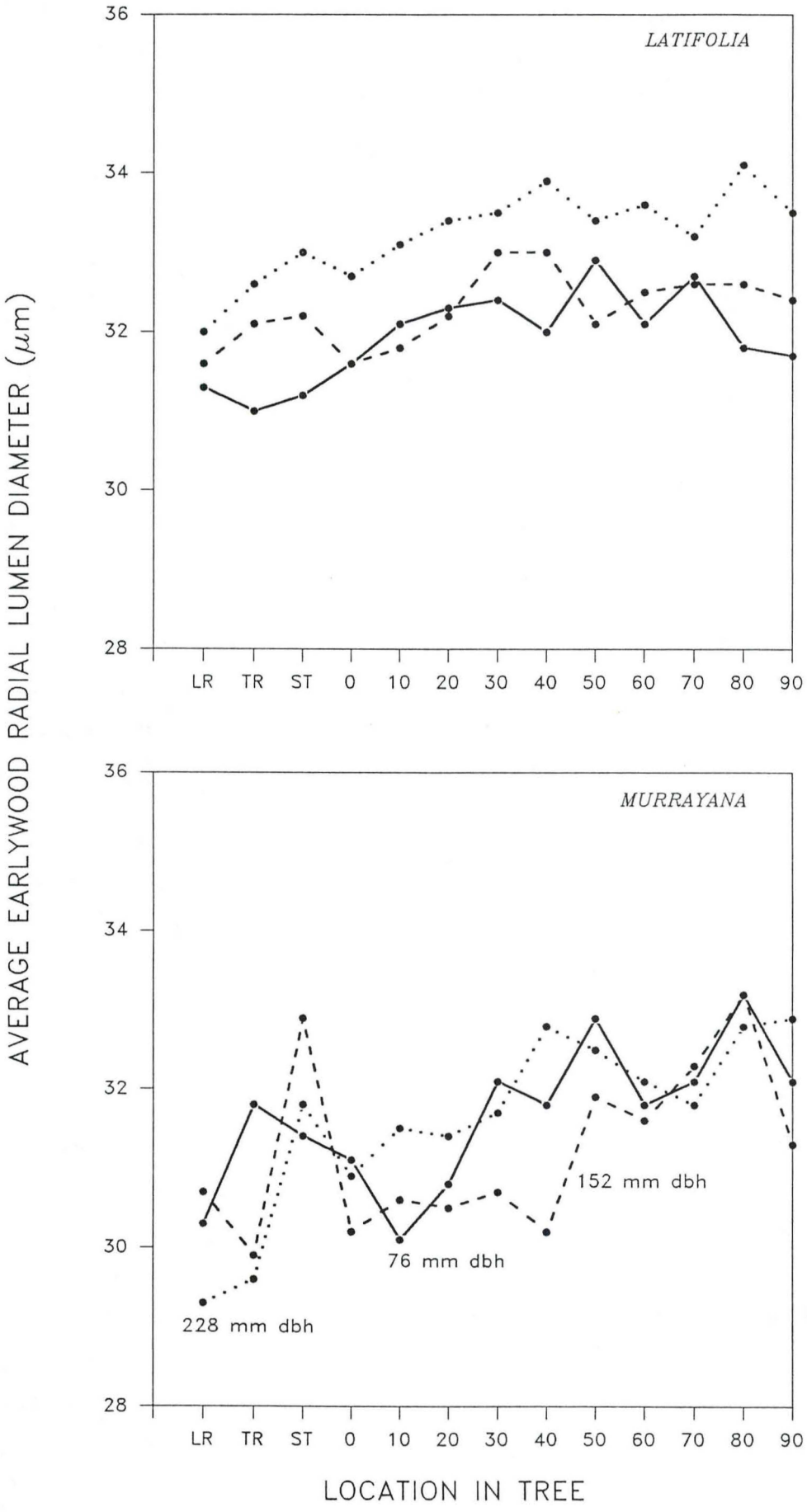
		LATITUDE			
		1	2	3	4
	LOC				
	0	32.44	34.22	27.67	28.56
	10	33.56	33.33	26.67	29.33
	20	34.33	32.44	27.22	29.56
	30	34.00	35.89	28.44	27.56
	40	34.11	34.33	28.78	29.00
	50	32.78	36.11	30.78	30.11
	60	32.00	36.22	30.22	28.89
	80	31.56	38.22	31.89	30.56
tap root		31.33	34.89	26.56	29.00

	ave	sd
70	32.03	4.91

		LATITUDE			
		1	2	3	4
	DBH				
90%	3	32.33	31.33	28.33	36.33
	6	32.00	37.67	29.33	29.33
	9	33.67	39.00	30.67	28.33
stump	3	30.00	29.33	27.00	39.33
	6	32.00	44.00	27.00	28.67
	9	33.67	36.67	30.67	26.33
teral root	3	27.67	29.33	28.33	35.67
	6	30.00	37.67	28.67	26.33
	9	30.00	34.67	27.67	25.00

Figure 14a. Average earlywood radial lumen diameter vs. position in the tree for all three diameters of var. latifolia. Plotted points based on data found in Table 2.

Figure 14b. Average earlywood radial lumen diameter vs. position in tree for all three diameters of var. murrayana. Plotted points based on data found in Table 3.


LATIFOLIA
MURRAYANA
AVERAGE EARLYWOOD RADIAL LUMEN DIAMETER (μm)
36
34
32
30
28
LR TR ST 0 10 20 30 40 50 60 70 80 90
152 mm dbh
76 mm dbh
228 mm dbh
LOCATION IN TREE

LATIFOLIA -- LATEWOOD RADIAL LUMEN DIAMETER

ANOVA results

for 0, 20, 30, 40, 50 and 90% of bole height as well as for the stump and tap root, the latitude means were significantly different at the 5% level

for 10, 60 and 80% of bole height, the LxExD interaction was significant

for 70% of bole height, the LxE and LxExD interactions were significant

for the lateral root, the latitude main effect as well as the ExD interaction were significant

NOTE: in the presence of interaction, inferences made about the main effects must be interpreted with caution

MURRAYANA -- LATEWOOD RADIAL LUMEN DIAMETER

ANOVA results : for 0, 30, 50 and 80% of bole height, the latitude means differed significantly at the 5% level; for 10%, diameter means were significantly different; for 40%, both the latitude and diameter main effects were significant

for stump and lateral root, there was a significant latitude by diameter interaction

	LATITUDE			
	1	2	3	4
LOC				
0	14.56	17.33	15.44	11.22
30	13.67	18.22	15.78	11.56
40	14.89	18.33	17.11	12.89
50	16.11	19.78	16.44	13.44
80	15.33	20.11	18.00	14.22

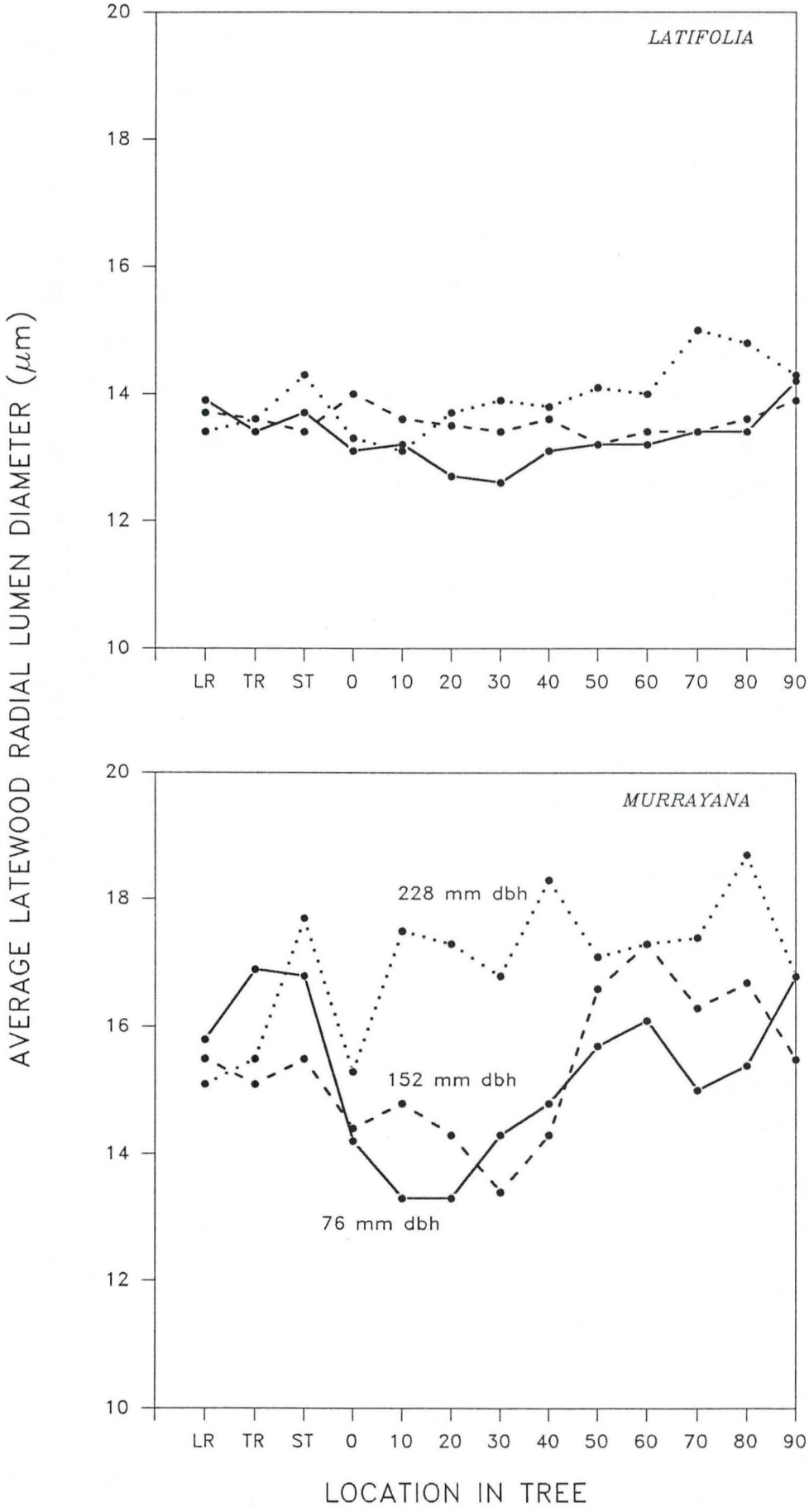
	DBH		
	1	2	3
LOC			
10	13.33	14.75	17.50
40	14.75	14.33	18.33

	ave	sd
20	14.94	4.50
60	16.89	4.61
70	16.22	4.52
90	16.36	4.59
tap root	15.83	5.55

		LATITUDE			
		1	2	3	4
	DBH				
stump	3	14.33	15.33	20.00	17.67
	6	9.33	23.33	17.00	12.33
	9	19.67	18.33	16.00	16.67
teral root	3	13.00	13.00	16.67	20.67
	6	10.33	23.00	17.33	11.33
	9	13.67	18.67	12.33	15.67

Figure 15a. Average latewood radial lumen diameter vs. position in the tree for all three diameters of var. latifolia. Plotted points based on data found in Table 2.

Figure 15b. Average latewood radial lumen diameter vs. position in tree for all three diameters of var. murrayana. Plotted points based on data found in Table 3.


LATIFOLIA
MURRAYANA
228 mm dbh
152 mm dbh
76 mm dbh
AVERAGE LATEWOOD RADIAL LUMEN DIAMETER (μm)
LOCATION IN TREE
20
18
16
14
12
10
LR TR ST 0 10 20 30 40 50 60 70 80 90

LATIFOLIA -- ANOVA RESULTS FOR WALL THICKNESS VARIABLES

1. EARLYWOOD TANGENTIAL WALL THICKNESS --latifolia

for 0 and 60% of bole height, the LxExD interaction was significant at the 5% level

for 20% of bole height, the LxD interaction was significant

for 30% of bole height as well as for stump and lateral root, the latitude means differed significantly

for 40 and 90% of bole height, the LxE interaction was found to be significant

for 50% of bole height as well as for tap root, the LxExD, LxE and LxD interactions were significant

for 70% of bole height, the LxE and ExD interactions were significant

for 80% of bole height, the LxExD and LxE interactions were significant at the 5% level

2. LATEWOOD TANGENTIAL WALL THICKNESS--latifolia

for 0 and 50% of bole height, the latitude and diameter means were significantly different at the 5% level

for 20, 30, 40 and 80% of bole height, only the latitude means differed significantly

for 60% of bole height, the LxE and ExD interactions were significant

for 90% of bole height as well as for stump, just the LxE interaction was significant

for tap root, the diameter means differed and the LxE interaction was significant

for lateral root, the LxExD interaction was significant at the 5% level

to differ significantly

for tap root, the latitude by diameter interaction was significant

LATIFOLIA -- ANOVA RESULTS FOR WALL THICKNESS VARIABLES (cont.)

3 . EARLYWOOD RADIAL WALL THICKNESS--latifolia

for 0 and 20% of bole height, the LxExD interaction was significant at the 5% level

for 70% of bole height, the LxExD and LxE interactions were significant

for 40 and 90% of bole height as well as for stump, the latitude means differed significantly

for 50 and 60% of bole height, the latitude and elevation means were significantly different

for 80% of bole height as well as for tap root, the LxE interaction was significant

4. LATEWOOD RADIAL WALL THICKNESS--latifolia

for 0 and 10% of bole height as well as for lateral root, the LxExD interaction was significant at the 5% level

for 20, 30, 40, 60 and 70% of bole height as well as for stump, the latitude means differed significantly at the 5% level

for 50% of bole height, the diameter means and the LxE interaction were significant

for 80 and 90% of bole height as well as for taproot, the LxE interaction was significant

MURRAYANA -- ANOVA RESULTS FOR WALL THICKNESS VARIABLES

1 . EARLYWOOD TANGENTIAL WALL THICKNESS

for 20% of bole height, latitude and diameter means were significantly different at the 5% level

for 50% of bole height, just the diameter means were found to differ significantly

for tap root, the latitude by diameter interaction was significant

2. LATEWOOD TANGENTIAL WALL THICKNESS

for 0, 10 and 20% of bole height as well as for stump, there was a significant latitude by diameter interaction

3. EARLYWOOD RADIAL WALL THICKNESS

for 20% of bole height, the latitude means differed at the 5% level of significance

for stump, there was a significant latitude by diameter interaction

for tap root, diameter means were significantly different

4. LATEWOOD RADIAL WALL THICKNESS

for 0, 10 and 90% of bole height, the latitude by diameter interaction was significant at the 5% level

for 20% of bole height, the latitude means were significantly different at the 5% level

for 30% of bole height, the diameter means were found to be significantly different

for 50% of bole height, the latitude and diameter means were significantly different

Figure 16a. Average earlywood tangential wall thickness vs. position in the tree for all three diameters of var. latifolia. Plotted points based on data found in Table 2.

Figure 16b. Average earlywood tangential wall thickness vs. position in tree for all three diameters of var. murrayana. Plotted points based on data found in Table 3.

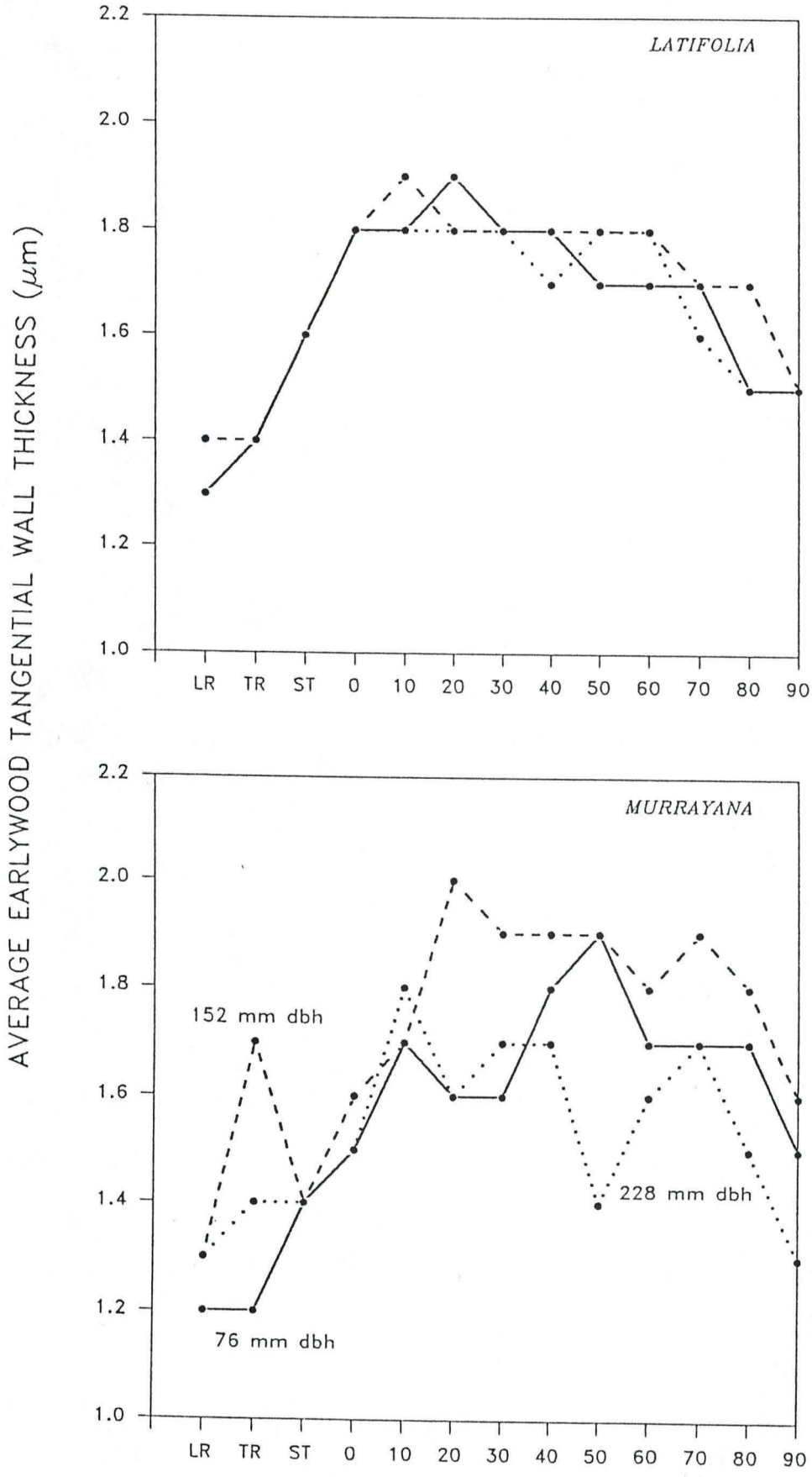

LATIFOLIA
MURRAYANA
152 mm dbh
228 mm dbh
76 mm dbh
AVERAGE EARLYWOOD TANGENTIAL WALL THICKNESS (μm)
2.2
2.0
1.8
1.6
1.4
1.2
1.0
LR TR ST 0 10 20 30 40 50 60 70 80 90
LOCATION IN TREE

Figure 17a. Average latewood tangential wall thickness vs. position in the tree for all three diameters of var. latifolia. Plotted points based on data found in Table 2.

Figure 17b. Average latewood tangential wall thickness vs. position in tree for all three diameters of var. murrayana. Plotted points based on data found in Table 3.

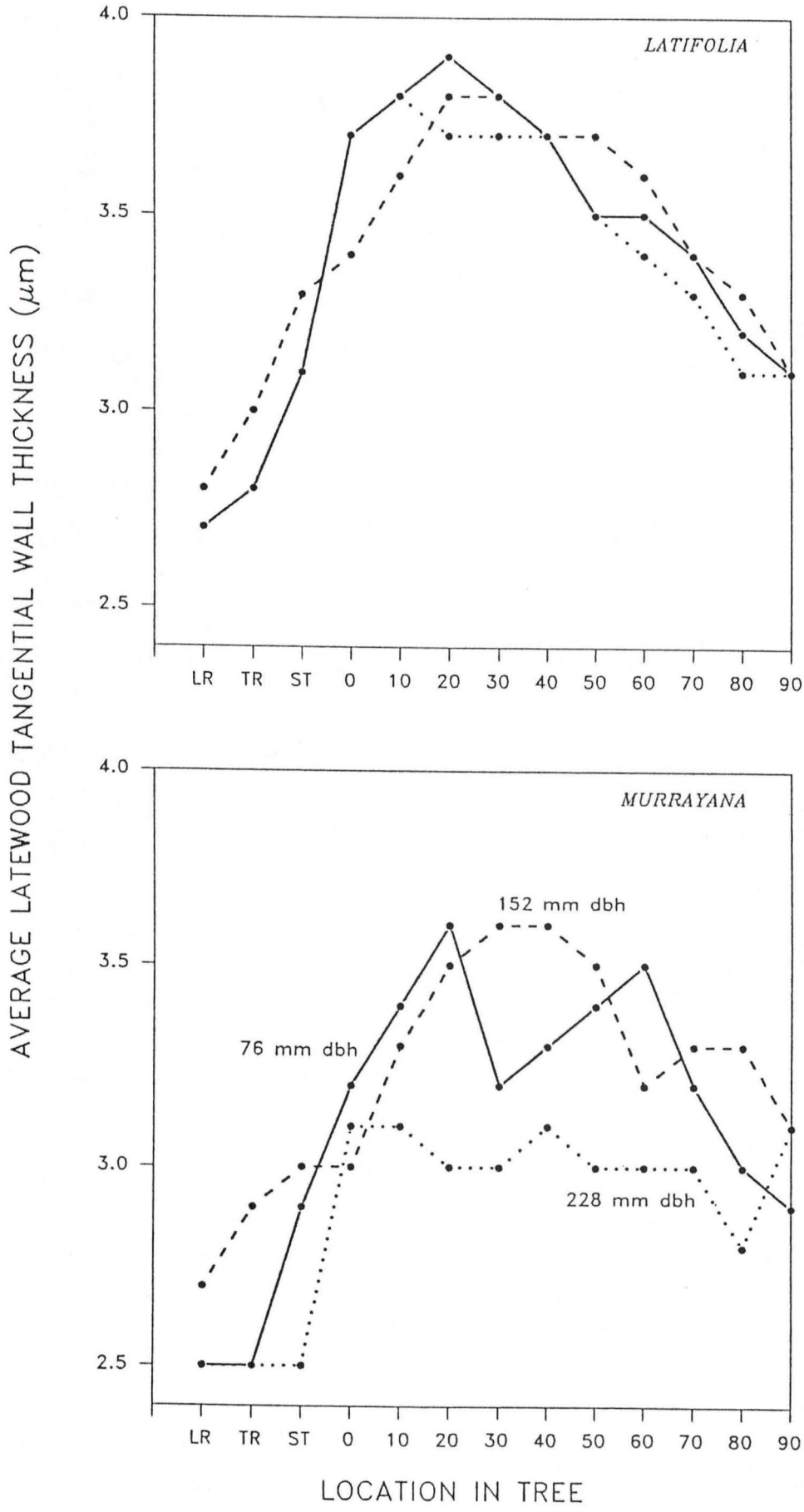

AVERAGE LATEWOOD TANGENTIAL WALL THICKNESS (μm)
4.0
3.5
3.0
2.5
LATIFOLIA
LR TR ST 0 10 20 30 40 50 60 70 80 90
MURRAYANA
152 mm dbh
76 mm dbh
228 mm dbh
LR TR ST 0 10 20 30 40 50 60 70 80 90
LOCATION IN TREE

Figure 18a. Average earlywood radial wall thickness vs. position in the tree for all three diameters of var. latifolia. Plotted points based on data found in Table 2.

Figure 18b. Average earlywood radial wall thickness vs. position in tree for all three diameters of var. murrayana. Plotted points based on data found in Table 3.

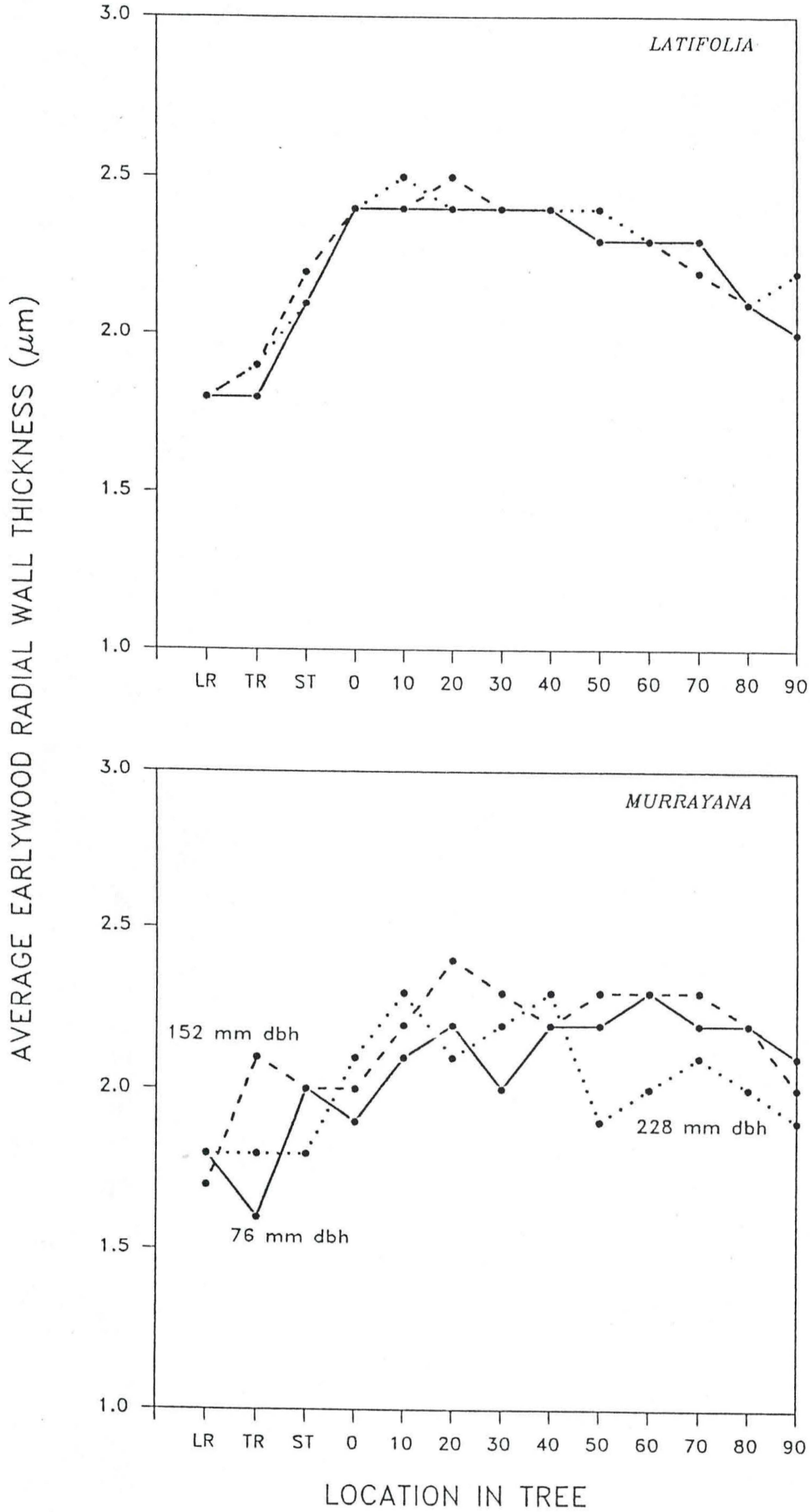

LATIFOLIA
MURRAYANA
AVERAGE EARLYWOOD RADIAL WALL THICKNESS (μm)
3.0
2.5
2.0
1.5
1.0
LR TR ST 0 10 20 30 40 50 60 70 80 90
152 mm dbh
76 mm dbh
228 mm dbh
LOCATION IN TREE

Figure 19a. Average latewood radial wall thickness vs. position in the tree for all three diameters of var. latifolia. Plotted points based on data found in Table 2.

Figure 19b. Average latewood radial wall thickness vs. position in tree for all three diameters of var. murrayana. Plotted points based on data found in Table 3.

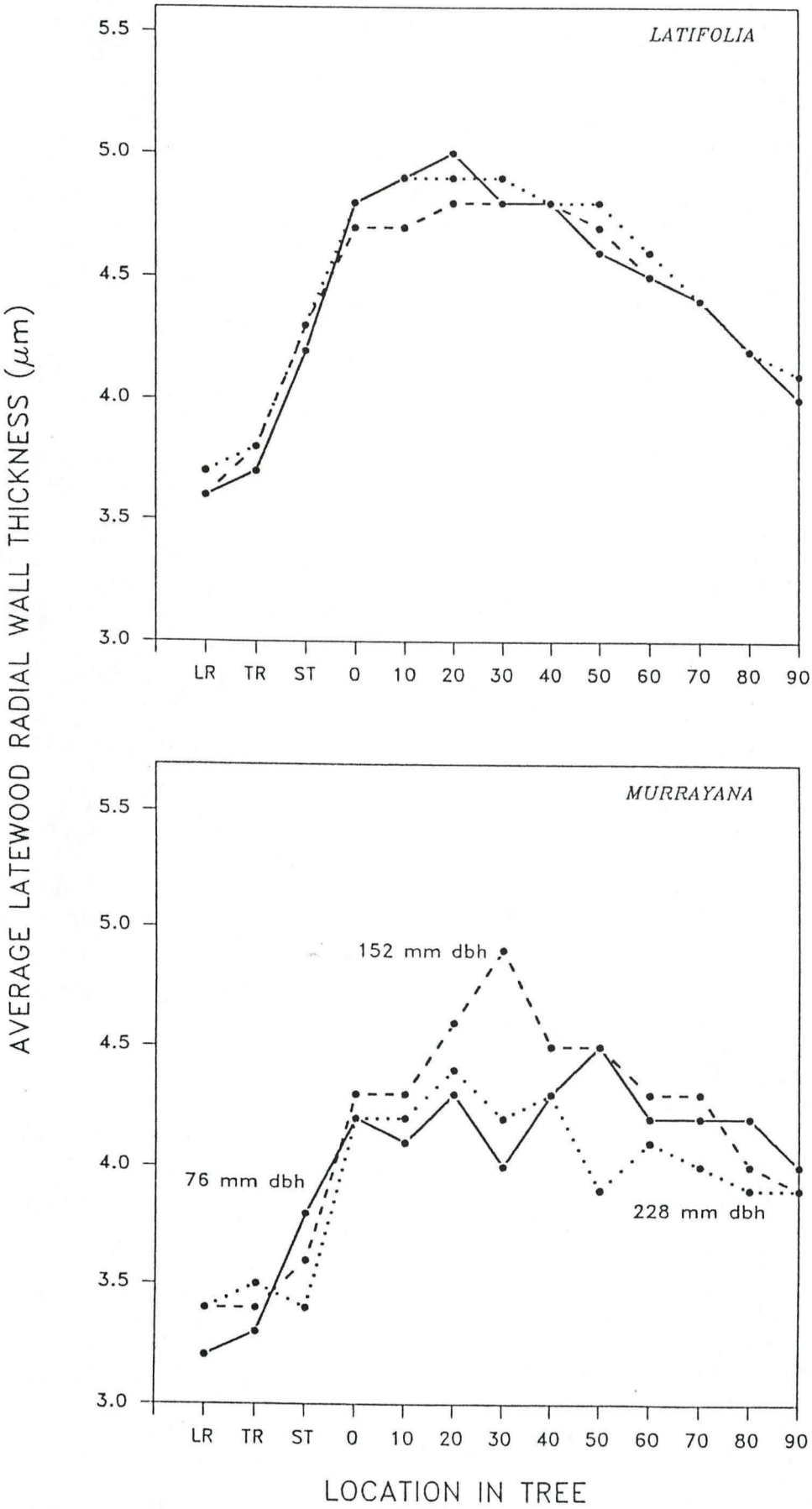

LATIFOLIA
MURRAYANA
152 mm dbh
76 mm dbh
228 mm dbh
5.5
5.0
4.5
4.0
3.5
3.0
LR TR ST 0 10 20 30 40 50 60 70 80 90
AVERAGE LATEWOOD RADIAL WALL THICKNESS (μm)
LOCATION IN TREE

Figure 20. Average latewood percentage vs. position in the tree for vars. latifolia and murrayana. Plotted points based on data found in Table 4a., where locations that are significantly different are also indicated.

Table 4a. Latewood percentage means for each location in the tree. Significant differences at 5% level are noted.

a. latewood percentage : varieties differ at all locations except 70% of bole height and stump(ST)

loc	LATIFOLIA	MURRAYANA
LR	9.66	11.64
TR	10.18	12.78
ST	12.61	13.14
0	14.96	17.17
10	15.53	18.28
20	15.51	18.11
30	15.19	18.06
40	14.88	17.78
50	14.23	15.69
60	13.73	15.47
70	12.99	13.94
80	12.04	13.94
90	11.18	13.25

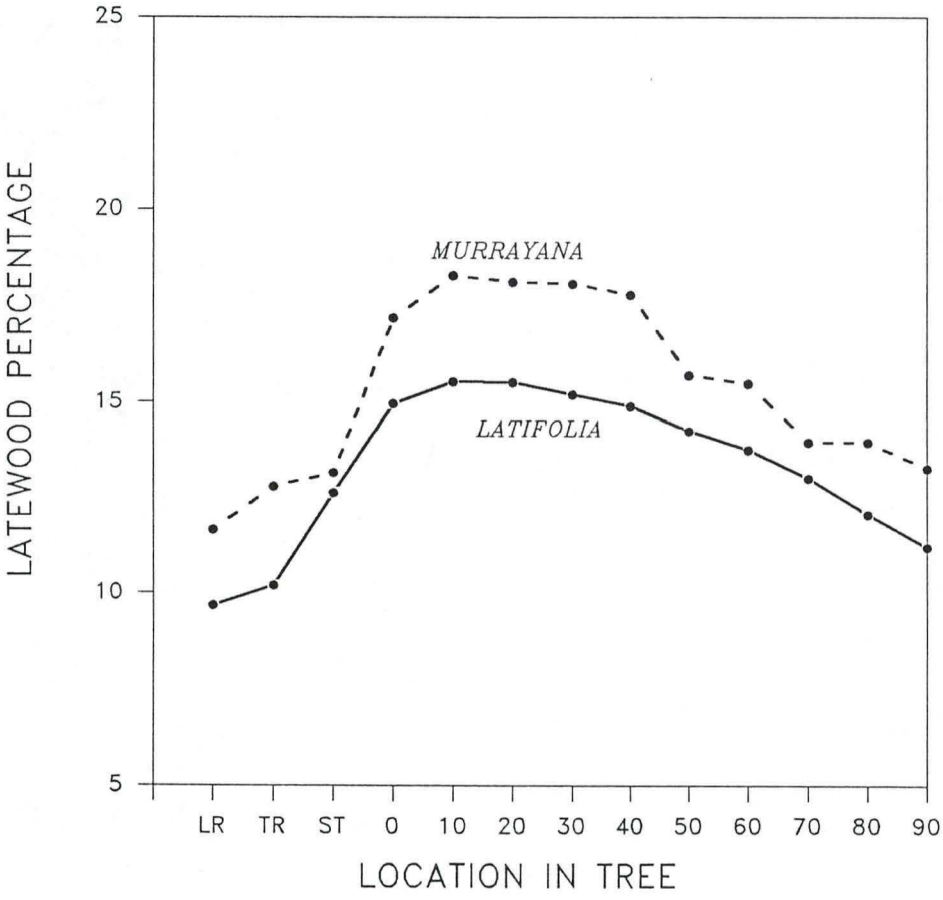

25
20
15
10
5
LATEWOOD PERCENTAGE
MURRAYANA
LATIFOLIA
LR
TR
ST
0
10
20
30
40
50
60
70
80
90
LOCATION IN TREE

Figure 21. Average resin canal number per unit area vs. position in the tree for vars. latifolia and murrayana. Plotted points based on data found in Table 4b., where locations that are significantly different are also indicated.

Table 4b. Resin canal number per unit area means for each location in the tree. Significant differences at 5% level are noted.

b. resin canal number : varieties significantly differ at only 40%, lateral root(LR), tap root(TR) and stump

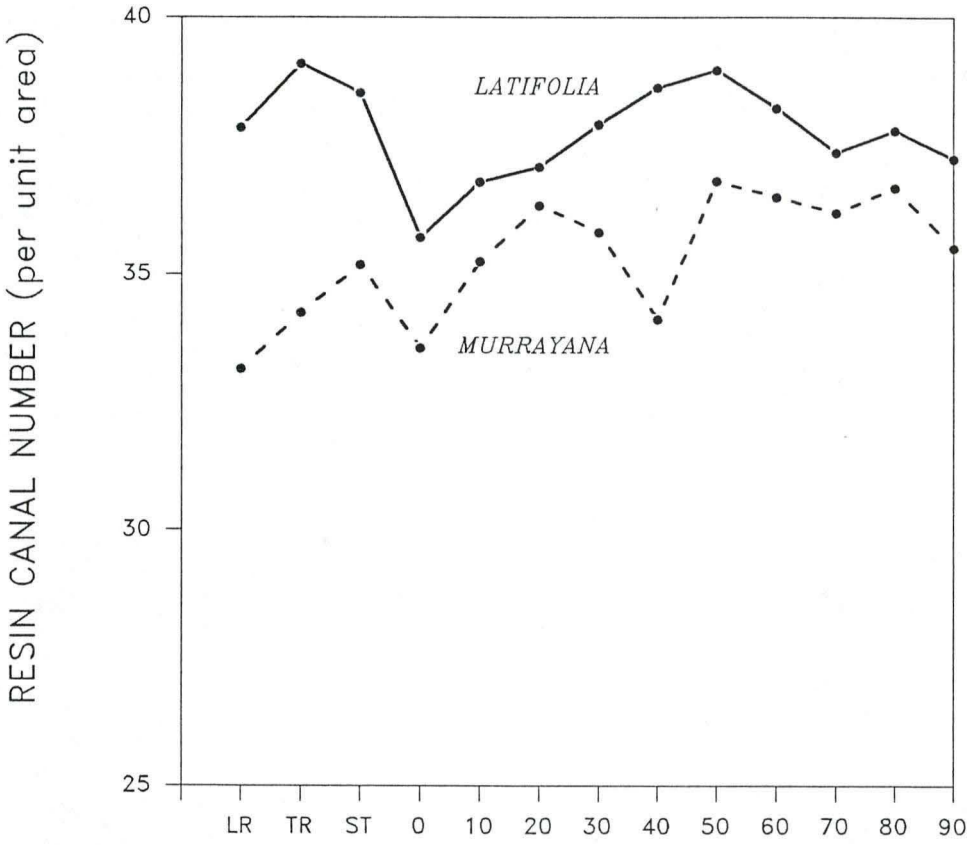
loc	LATIFOLIA	MURRAYANA
LR	37.85	33.14
TR	39.09	34.25
ST	38.52	35.19
0	35.72	33.56
10	36.80	35.25
20	37.09	36.33
30	37.91	35.81
40	38.63	34.11
50	38.96	36.81
60	38.22	36.50
70	37.36	36.19
80	37.79	36.67
90	37.23	35.50

Figure 22. Average resin canal diameter vs. position in the tree for vars. latifolia and murrayana. Plotted points based on data found in Table 4c., where locations that are significantly different are also indicated.

Table 4c. Resin canal diameter means for each location in the tree. Significant differences at 5% level are noted.

c. resin canal diam : varieties differ significantly at 50%, 60%, 70% and lateral root

loc	LATIFOLIA	MURRAYANA
LR	70.67	73.03
TR	72.24	72.97
ST	72.71	73.67
0	70.98	71.67
10	71.65	72.03
20	71.32	72.83
30	72.24	72.67
40	72.53	74.08
50	73.00	77.08
60	72.70	75.61
70	72.26	76.72
80	72.88	74.22
90	72.65	74.03


RESIN CANAL NUMBER (per unit area)
40
35
30
25
LATIFOLIA
MURRAYANA
LR TR ST 0 10 20 30 40 50 60 70 80 90

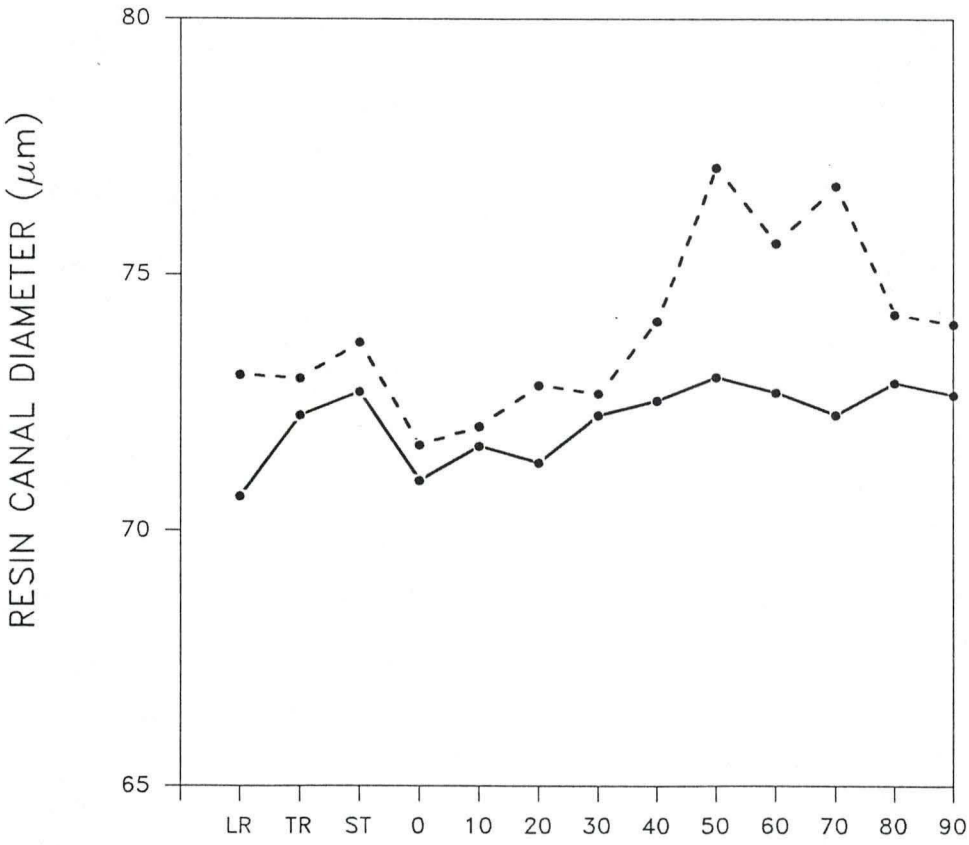

RESIN CANAL DIAMETER (μm)
80
75
70
65
LR TR ST 0 10 20 30 40 50 60 70 80 90
LOCATION IN TREE

Figure 23a. Average earlywood tracheid length vs. position in the tree for vars. latifolia and murrayana. Plotted points based on data found in Table 4d., where locations that are significantly different are also indicated.

Table 4d. Earlywood tracheid length means for each location in the tree. Significant differences at 5% level are noted.

d. earlywood fiber length : varieties significantly differ at all locations except stump

loc	LATIFOLIA	MURRAYANA
LR	1.90	2.12
TR	2.09	2.34
ST	2.38	2.52
0	2.04	2.55
10	2.12	2.65
20	2.16	2.68
30	2.20	2.74
40	2.21	2.74
50	2.19	2.76
60	2.14	2.73
70	2.08	2.60
80	2.04	2.61
90	1.93	2.55

Figure 23b. Average latewood tracheid length vs. position in the tree for vars. latifolia and murrayana. Plotted points based on data found in Table 4e., where locations that are significantly different are also indicated.

Table 4e. Latewood tracheid length means for each location in the tree. Significant differences at 5% level are noted.

e. latewood fiber length : varieties differ at all locations except lateral root, tap root and stump

loc	LATIFOLIA	MURRAYANA
LR	2.50	2.54
TR	2.70	2.78
ST	3.10	3.14
0	2.49	3.41
10	2.64	3.49
20	2.67	3.59
30	2.69	3.64
40	2.69	3.63
50	2.67	3.68
60	2.58	3.48
70	2.52	3.38
80	2.47	3.33
90	2.28	3.15

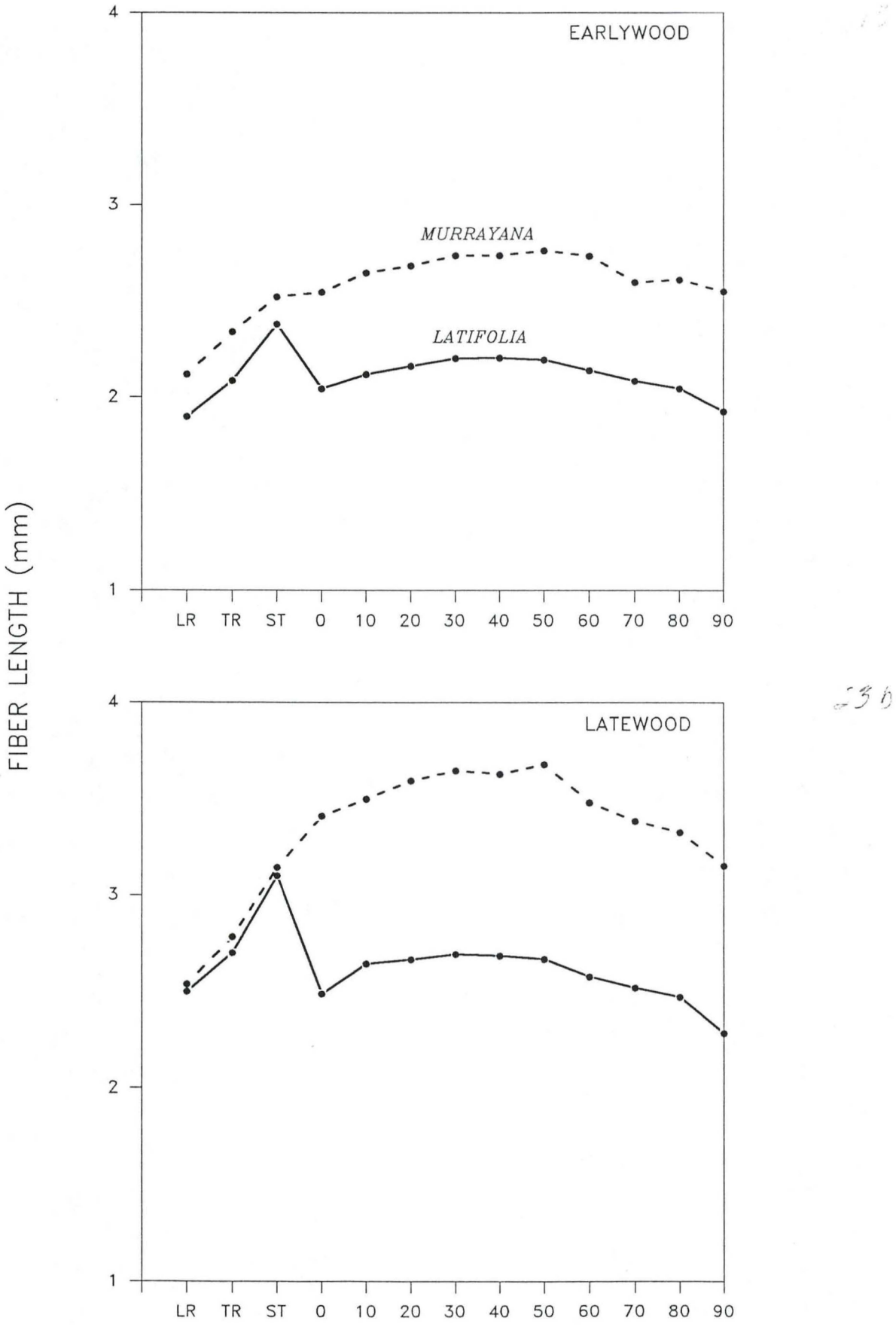

EARLYWOOD
MURRAYANA
LATIFOLIA
LATEWOOD
FIBER LENGTH (mm)
LOCATION IN TREE
LR TR ST 0 10 20 30 40 50 60 70 80 90
1
2
3
4

Figure 24a. Average earlywood microfibril angle vs. position in the tree for vars. latifolia and murrayana. Plotted points based on data found in Table 4f., where locations that are significantly different are also indicated.

Table 4f. Earlywood microfibril angle means for each location in the tree. Significant differences at 5% level are noted.

f. earlywood microfibril angle : varieties significantly differ at only 60% and stump

loc	LATIFOLIA	MURRAYANA
LR	34.75	35.47
TR	33.10	34.17
ST	31.39	33.47
0	27.43	26.83
10	27.98	27.03
20	27.12	26.97
30	27.60	27.03
40	28.38	27.00
50	27.54	26.28
60	27.69	25.39
70	27.57	26.81
80	28.38	27.69
90	28.61	28.03

Figure 24b. Average latewood microfibril angle vs. position in the tree for vars. latifolia and murrayana. Plotted points based on data found in Table 4g., where locations that are significantly different are also indicated.

Table 4g. Latewood microfibril angle means for each location in the tree. Significant differences at 5% level are noted.

g. latewood microfibril angle : varieties differ at all locations except lateral root

loc	LATIFOLIA	MURRAYANA
LR	27.96	28.89
TR	26.00	27.69
ST	24.12	26.44
0	22.21	18.19
10	22.01	18.33
20	21.76	18.03
30	21.68	18.39
40	22.13	19.00
50	21.72	17.61
60	21.58	18.11
70	21.59	18.42
80	22.24	19.44
90	23.45	19.72

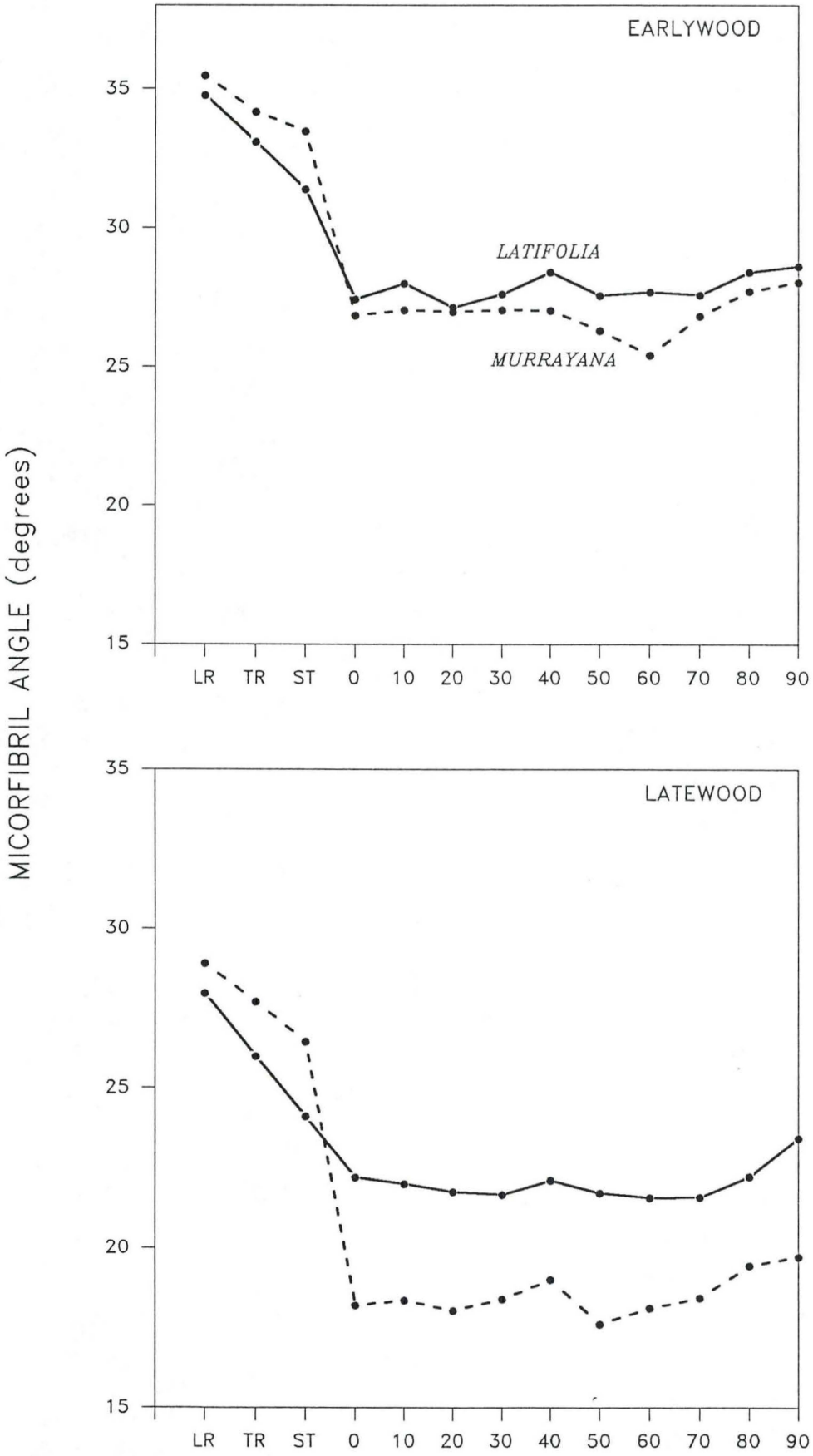

EARLYWOOD
LATIFOLIA
MURRAYANA
LATEWOOD
MICORFIBRIL ANGLE (degrees)
35
30
25
20
15
LR
TR
ST
0
10
20
30
40
50
60
70
80
90
LOCATION IN TREE

Figure 25a. Average earlywood tangential cell diameter vs. position in the tree for vars. latifolia and murrayana. Plotted points based on data found in Table 4h., where locations that are significantly different are also indicated.

Table 4h. Earlywood tangential cell diameter means for each location in the tree. Significant differences at 5% level are noted.

h. earlywood tangential cell diam : varieties differ significantly only for 30% and lateral root

loc	LATIFOLIA	MURRAYANA
LR	32.37	30.81
TR	32.74	31.58
ST	33.36	32.97
0	33.46	32.56
10	34.16	32.78
20	34.52	33.00
30	34.78	32.83
40	34.84	34.17
50	34.47	34.50
60	34.48	33.61
70	34.23	34.67
80	34.01	34.31
90	33.82	33.53

Figure 25b. Average latewood tangential cell diameter vs. position in the tree for vars. latifolia and murrayana. Plotted points based on data found in Table 4i., where locations that are significantly different are also indicated.

Table 4i. Latewood tangential cell diameter means for each location in the tree. Significant differences at 5% level are noted.

i. latewood tangential cell diam : varieties differ at 40%, 50%, 60%, 70%, 80% and stump

loc	LATIFOLIA	MURRAYANA
LR	26.31	27.22
TR	26.51	27.47
ST	27.28	28.78
0	27.42	27.83
10	27.77	28.47
20	27.96	28.97
30	28.19	28.64
40	28.32	29.81
50	27.86	30.36
60	27.72	30.14
70	27.83	29.86
80	27.47	30.11
90	27.58	28.78

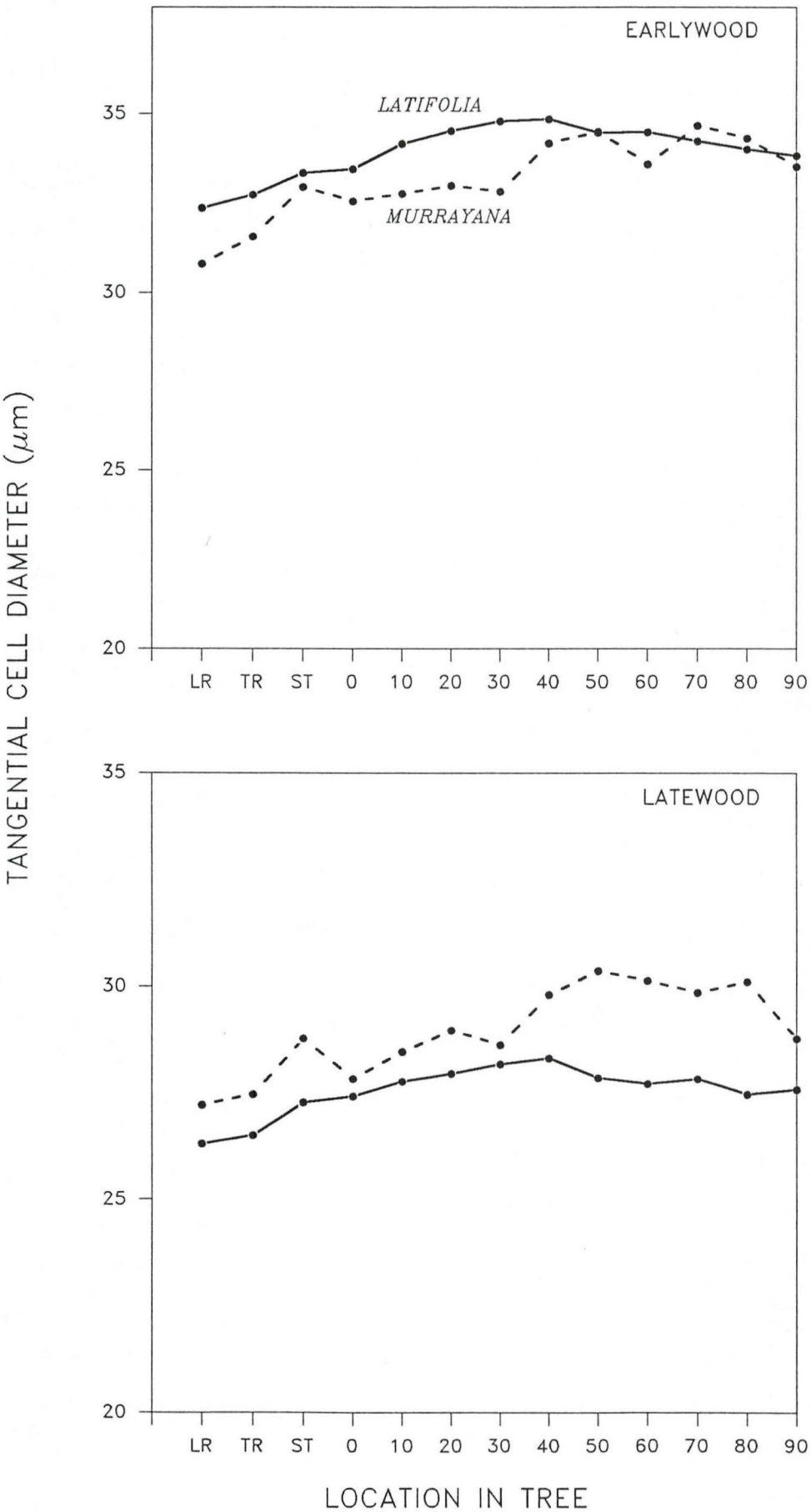

EARLYWOOD
LATIFOLIA
MURRAYANA
LATEWOOD
TANGENTIAL CELL DIAMETER (μm)
35
30
25
20
LR
TR
ST
0
10
20
30
40
50
60
70
80
90
LOCATION IN TREE

Figure 26a. Average earlywood tangential lumen diameter vs. position in the tree for vars. latifolia and murrayana. Plotted points based on data found in Table 4j., where locations that are significantly different are also indicated.

Table 4j. Earlywood tangential lumen diameter means for each location in the tree. Significant differences at 5% level are noted.

j. earlywood tangential lumen diam : varieties differ significantly only at 30%

loc	LATIFOLIA	MURRAYANA
LR	28.71	27.31
TR	28.93	27.89
ST	29.07	29.11
0	28.68	28.58
10	29.32	28.39
20	29.62	28.53
30	30.02	28.44
40	30.06	29.69
50	29.76	30.25
60	29.88	29.19
70	29.74	30.33
80	29.73	30.11
90	29.67	29.25

Figure 26b. Average latewood tangential lumen diameter vs. position in the tree for vars. latifolia and murrayana. Plotted points based on data found in Table 4k., where locations that are significantly different are also indicated.

Table 4k. Latewood tangential lumen diameter means for each location in the tree. Significant differences at 5% level are noted.

k. latewood tangential lumen diam : varieties are significantly different at all locations except 30%, 90% and tap root

loc	LATIFOLIA	MURRAYANA
LR	19.05	20.58
TR	18.92	20.42
ST	18.77	21.31
0	17.84	19.42
10	18.05	20.33
20	18.17	20.08
30	18.60	20.00
40	18.74	21.11
50	18.49	21.78
60	18.60	21.78
70	19.05	21.31
80	19.09	21.78
90	19.46	20.86

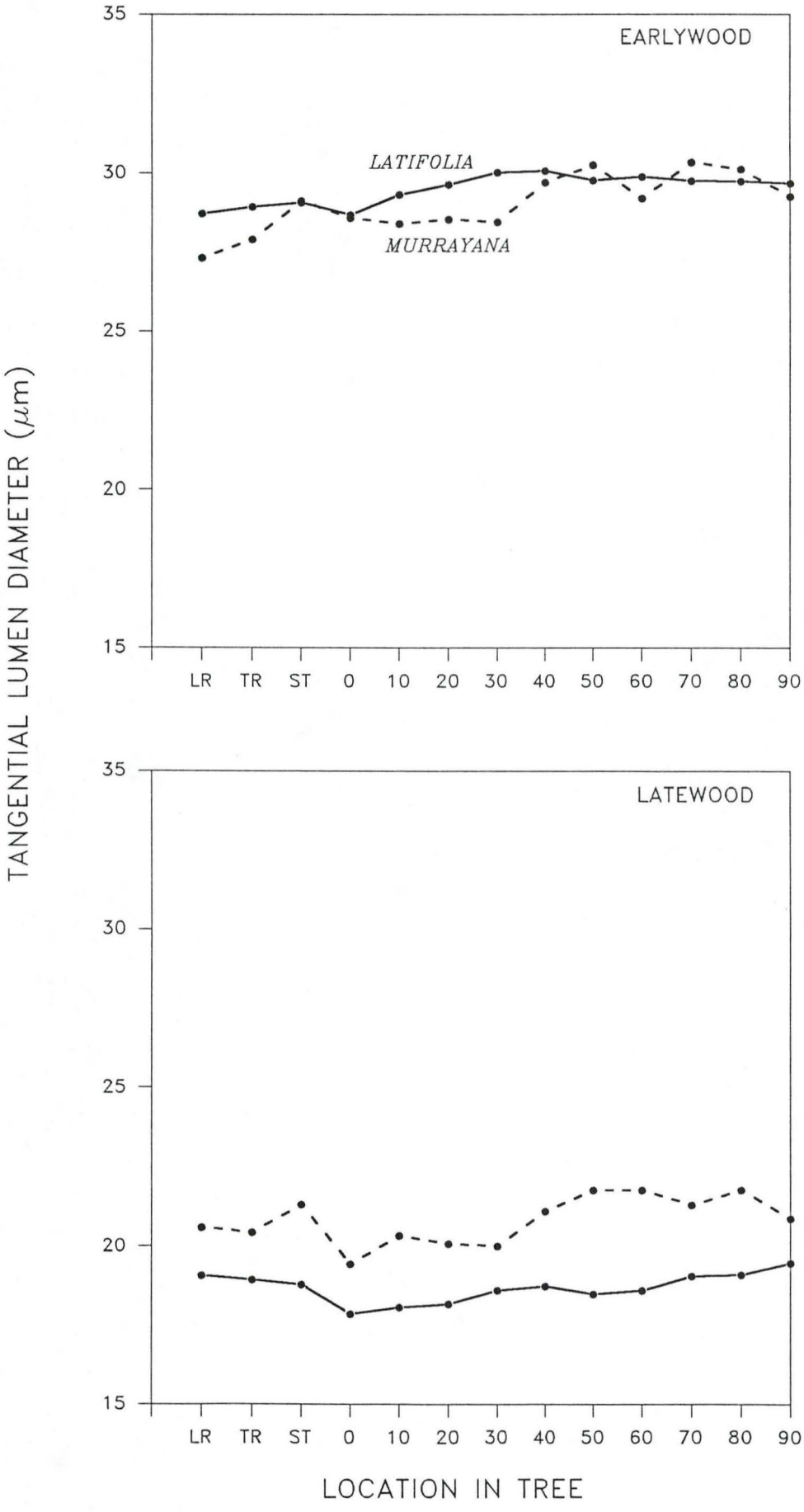

EARLYWOOD
LATIFOLIA
MURRAYANA
LATEWOOD
TANGENTIAL LUMEN DIAMETER (μm)
35
30
25
20
15
LR TR ST 0 10 20 30 40 50 60 70 80 90
LOCATION IN TREE

Figure 27a. Average earlywood radial cell diameter vs. position in the tree for vars. latifolia and murrayana. Plotted points based on data found in Table 41., where locations that are significantly different are also indicated.

Table 41. Earlywood radial cell diameter means for each location in the tree. Significant differences at 5% level are noted.

l. earlywood radial cell diam : varieties significantly different at 10% and 20%

loc	LATIFOLIA	MURRAYANA
LR	34.33	32.64
TR	34.73	33.31
ST	35.30	34.89
0	35.53	33.86
10	35.99	34.14
20	36.35	34.31
30	36.62	34.94
40	36.60	35.14
50	36.33	35.89
60	36.30	35.25
70	36.19	35.53
80	36.00	36.33
90	35.60	35.31

Figure 27b. Average latewood radial cell diameter vs. position in the tree for vars. latifolia and murrayana. Plotted points based on data found in Table 4m., where locations that are significantly different are also indicated.

Table 4m. Latewood radial cell diameter means for each location in the tree. Significant differences at 5% level are noted.

m. latewood radial cell diam : varieties differ significantly at 50%, 60%, 70%, 80%, 90%, tap root and stump

loc	LATIFOLIA	MURRAYANA
LR	19.13	20.53
TR	19.26	21.08
ST	20.12	22.25
0	20.68	20.83
10	20.74	21.72
20	20.88	21.56
30	20.83	21.36
40	20.94	22.47
50	20.67	23.11
60	20.54	23.36
70	20.67	22.50
80	20.38	22.97
90	20.37	22.44

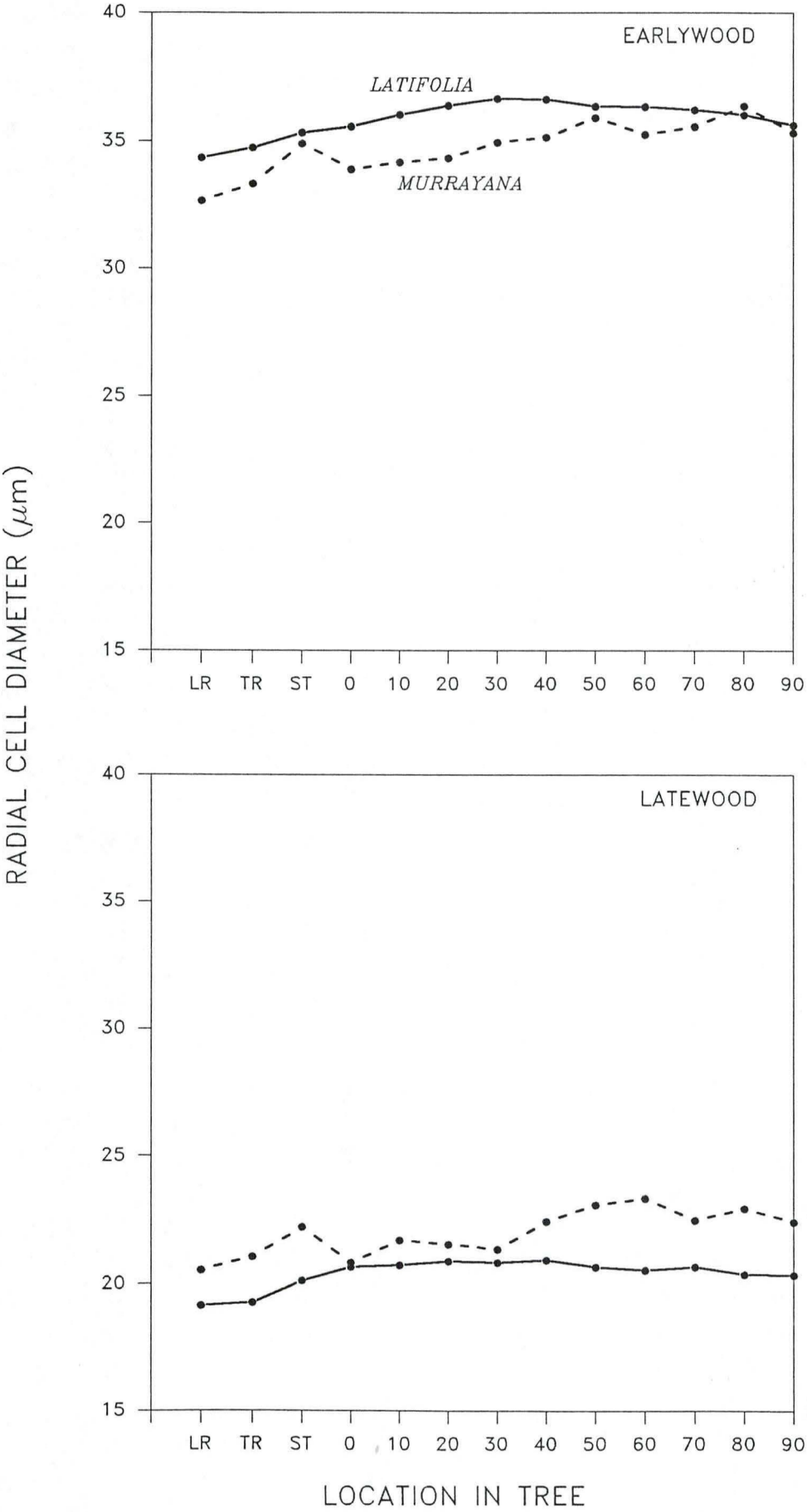

EARLYWOOD
LATIFOLIA
MURRAYANA
LATEWOOD
RADIAL CELL DIAMETER (μm)
40
35
30
25
20
15
LR TR ST 0 10 20 30 40 50 60 70 80 90
LOCATION IN TREE

Figure 28a. Average earlywood radial lumen diameter vs. position in the tree for vars. latifolia and murrayana. Plotted points based on data found in Table 4n., where locations that are significantly different are also indicated.

Table 4n. Earlywood radial lumen diameter means for each location in the tree. Significant differences at 5% level are noted.

n. earlywood radial lumen diam : varieties differ significantly only at 20%

loc	LATIFOLIA	MURRAYANA
LR	31.67	30.08
TR	31.91	30.44
ST	32.11	32.06
0	31.97	30.72
10	32.31	30.72
20	32.65	30.89
30	32.95	31.47
40	32.98	31.56
50	32.79	32.44
60	32.75	31.83
70	32.84	32.03
80	32.84	33.06
90	32.53	32.11

Figure 28b. Average latewood radial lumen diameter vs. position in the tree for vars. latifolia and murrayana. Plotted points based on data found in Table 4o., where locations that are significantly different are also indicated.

Table 4o. Latewood radial lumen diameter means for each location in the tree. Significant differences at 5% level are noted.

o. latewood radial lumen diam : varieties significantly different except for 0%, 30% and lateral root

loc	LATIFOLIA	MURRAYANA
LR	13.66	15.47
TR	13.53	15.83
ST	13.81	16.67
0	13.47	14.64
10	13.28	15.19
20	13.29	14.94
30	13.31	14.81
40	13.52	15.81
50	13.47	16.44
60	13.53	16.89
70	13.90	16.22
80	13.94	16.92
90	14.13	16.36

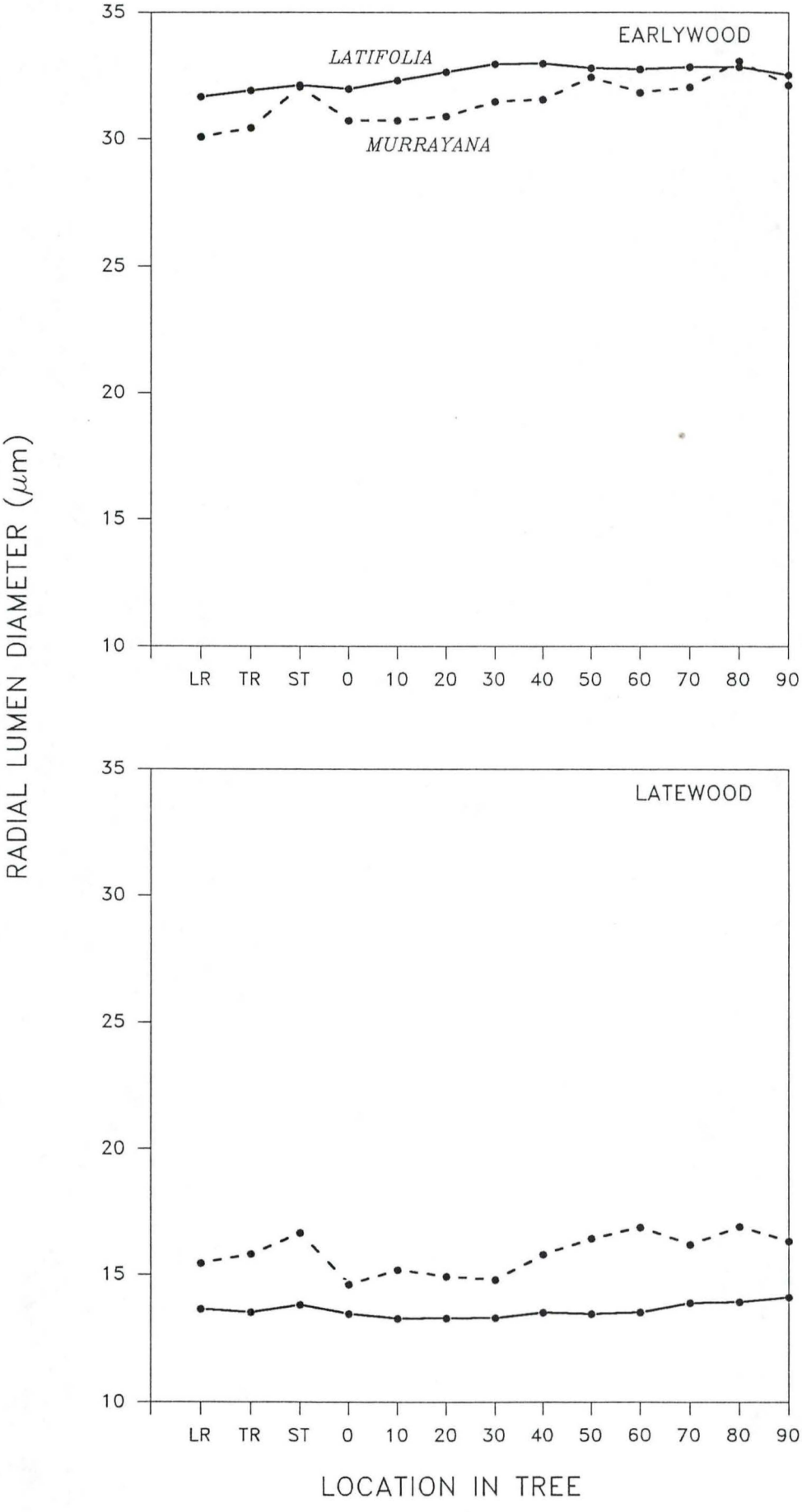

EARLYWOOD
LATIFOLIA
MURRAYANA
LATEWOOD
RADIAL LUMEN DIAMETER (μm)
35
30
25
20
15
10
LR
TR
ST
0
10
20
30
40
50
60
70
80
90
LOCATION IN TREE

Figure 29a. Average earlywood tangential wall thickness vs. position in the tree for vars. latifolia and murrayana. Plotted points based on data found in Table 4p., where locations that are significantly different are also indicated.

Table 4p. Earlywood tangential wall thickness means for each location in the tree. Significant differences at 5% level are noted.

p. earlywood tangential wall thickness varieties significantly differ only for 0% and stump

loc	LATIFOLIA	MURRAYANA
LR	1.33	1.28
TR	1.41	1.43
ST	1.59	1.42
0	1.78	1.57
10	1.84	1.71
20	1.85	1.74
30	1.83	1.74
40	1.79	1.79
50	1.77	1.72
60	1.77	1.71
70	1.67	1.75
80	1.58	1.64
90	1.53	1.46

Figure 29b. Average latewood tangential wall thickness vs. position in the tree for vars. latifolia and murrayana. Plotted points based on data found in Table 4q., where locations that are significantly different are also indicated.

Table 4q. Latewood tangential wall thickness means for each location in the tree. Significant differences at 5% level are noted.

q. latewood tangential wall thick. varieties differ significantly at all locations except 70%, 80% and 90%

loc	LATIFOLIA	MURRAYANA
LR	2.74	2.53
TR	2.86	2.63
ST	3.15	2.79
0	3.61	3.10
10	3.73	3.26
20	3.79	3.36
30	3.76	3.28
40	3.71	3.33
50	3.60	3.33
60	3.50	3.24
70	3.36	3.14
80	3.22	3.03
90	3.12	3.04

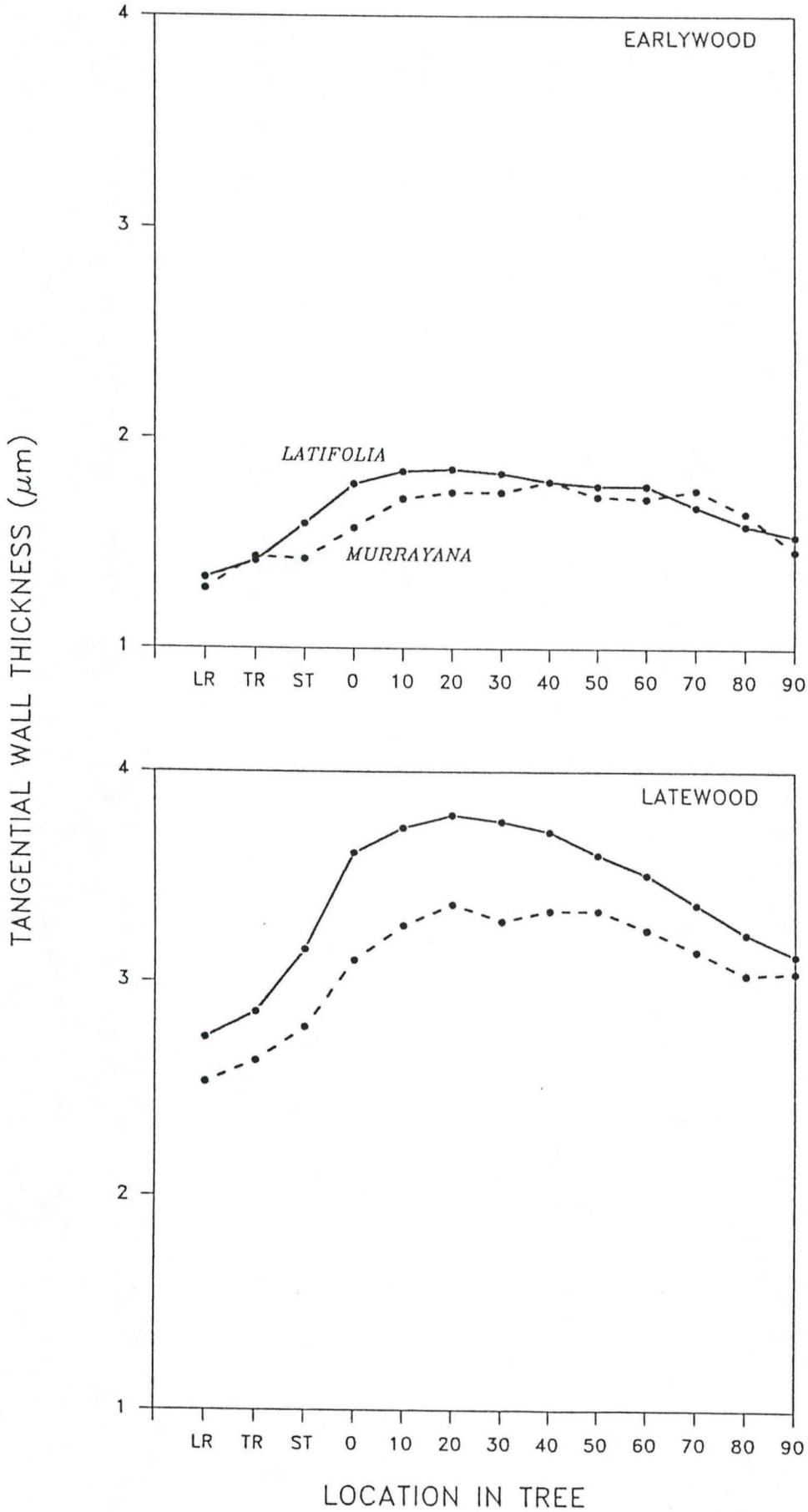

EARLYWOOD
LATIFOLIA
MURRAYANA
LATEWOOD
TANGENTIAL WALL THICKNESS (μm)
LOCATION IN TREE
4
3
2
1
LR
TR
ST
0
10
20
30
40
50
60
70
80
90

Figure 30a. Average earlywood radial wall thickness vs. position in the tree for vars. latifolia and murrayana. Plotted points based on data found in Table 4r., where locations that are significantly different are also indicated.

Table 4r. Earlywood radial wall thickness means for each location in the tree. Significant differences at 5% level are noted.

r. earlywood radial wall thickness : varieties differ at 0%, 10%, 20%, 30%, 50% and stump

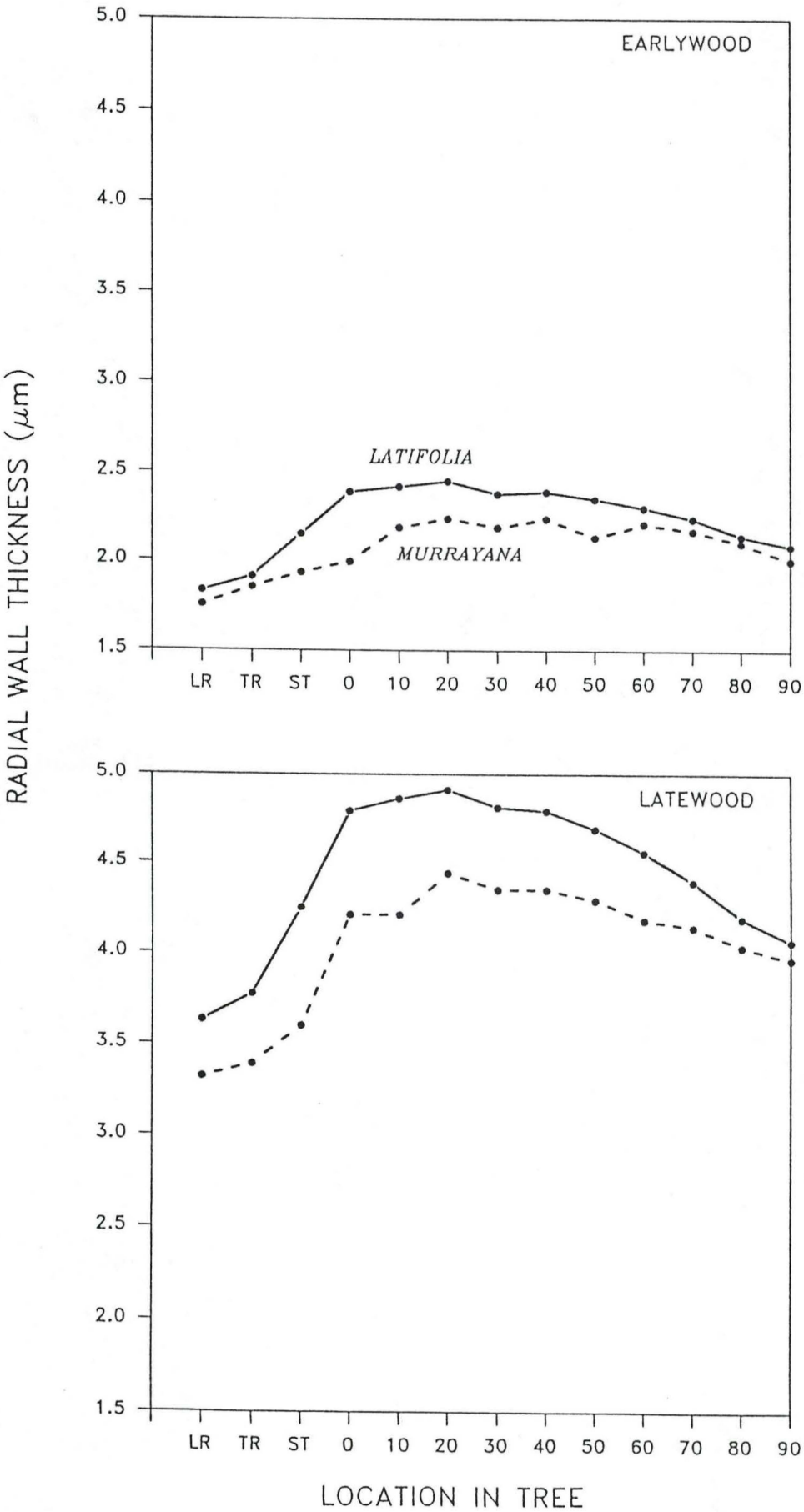
loc	LATIFOLIA	MURRAYANA
LR	1.83	1.75
TR	1.91	1.85
ST	2.15	1.93
0	2.39	1.99
10	2.42	2.19
20	2.45	2.24
30	2.38	2.19
40	2.39	2.24
50	2.35	2.13
60	2.30	2.21
70	2.24	2.17
80	2.14	2.10
90	2.08	2.00

Figure 30b. Average latewood radial wall thickness vs. position in the tree for vars. latifolia and murrayana. Plotted points based on data found in Table 4s., where locations that are significantly different are also indicated.

Table 4s. Latewood radial wall thickness means for each location in the tree. Significant differences at 5% level are noted.

S. latewood radial wall thickness : varieties significantly differ at all locations except 80% and 90%

loc	LATIFOLIA	MURRAYANA
LR	3.63	3.32
TR	3.77	3.39
ST	4.25	3.60
0	4.79	4.21
10	4.86	4.21
20	4.91	4.44
30	4.81	4.35
40	4.79	4.35
50	4.69	4.29
60	4.56	4.18
70	4.39	4.14
80	4.19	4.03
90	4.06	3.96


EARLYWOOD
LATEWOOD
LATIFOLIA
MURRAYANA
RADIAL WALL THICKNESS (μm)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
LR TR ST 0 10 20 30 40 50 60 70 80 90
LOCATION IN TREE

CORRELATIONS BY HEIGHT -- LATIFOLIA (n=243)

only correlations significant at the 5% level are reported here;
the Pearson correlation is given with the p-value in parentheses

1. stem bark thickness, mm

with latewood angle : 20% of bole height = .151(.019)

resin canal diameter : 90% = -.139(.03)

earlywood angle : 20% = .130(.043)

LWTCD : 30% = .164(.01)
80% = .130(.04)

LWTLD : 20% = .161(.01)
30% = .148(.02)
80% = .132(.04)

LWRCD : 30% = .131(.04)

LWRLD : 30% = .146(.02)

LWTWT : 20% = -.141(.027)

EWTCD : 80% = .182(.004)

EWTLD : 80% = .173(.007)

EWRWT : 20% = -.182(.005)

EWRCD : 40% = .130(.043)
80% = .178(.005)
90% = .159(.013)

EWRLD : 40% = .163(.01)
80% = .169(.008)
90% = .155(.016)

EWTWT : 20% = -.206(.001)
40% = -.137(.03)

2. stem bark specific gravity

with latewood length : 20% = -.136(.03)
40% = -.137(.03)

latewood angle : 20% = .251(.0001)
30% = .129(.045)
40% = .157(.014)
70% = .189(.003)
80% = .185(.004)

latewood percent : 0% = .167(.009)

resin canal number : 20% = .135(.036)

resin canal diameter : 50% = -.136(.034)

earlywood length : 20% = -.127(.049)
30% = -.152(.018)
40% = -.185(.004)

earlywood angle : 20% = .187(.004) 70% = .214(.001)
30% = .193(.003) 80% = .190(.003)
40% = .175(.006) 90% = .140(.03)

LWTCD : 10% = -.142(.027)
80% = .129(.044)

LWTLD : 80% = .163(.01)

LWRWT : 10% = -.133(.039) 50% = -.137(.03)
20% = -.187(.003) 70% = -.159(.013)
40% = -.146(.023) 80% = -.145(.024)

LWRLD : 80% = .136(.034)

LWTWT : 10% = -.130(.043)
20% = -.187(.004)

EWTCD : 20% = -.189(.003)

EWTLD : 20% = -.141(.028)

EWRWT : 20% = -.226(.0004)
70% = -.182(.004)
80% = -.156(.015)

EWRCD : 20% = -.200(.002)
30% = -.127(.048)

EWRLD : 20% = -.168(.009)

EWTWT : 20% = -.158(.014) 70% = -.172(.007)
40% = -.155(.016) 80% = -.153(.017)
60% = -.127(.049) 90% = -.170(.008)

3. stem bark moisture content, %

with latewood angle : 0% = -.136(.034) 70% = -.130(.044)
20% = -.186(.004) 80% = -.148(.02)
40% = -.185(.004)

latewood percent : 90% = .135(.036)

earlywood angle : 20% = -.219(.001) 70% = -.134(.036)
30% = -.160(.013) 80% = -.162(.011)
40% = -.208(.001) 90% = -.147(.022)
50% = -.151(.019)

LWTCD : 80% = -.132(.04)

LWTLD : 50% = -.135(.035)
80% = -.153(.017)

LWRWT : 20% = .172(.007)
40% = .150(.019)
70% = .165(.01)

LWRCD : 80% = -.128(.047)

LWRLD : 80% = -.141(.03)

LWTWT : 0% = .160(.012)
20% = .211(.001)

EWTCD : 20% = .156(.015)

EWTLD : 20% = .135(.035)

EWRWT : 70% = .187(.004)

EWRCD : 20% = .141(.028)

EWTWT : 40% = .153(.017) 80% = .139(.03)
70% = .182(.004) 90% = .154(.016)

4. stemwood moisture content, %

with latewood angle : 0% = -.257(.0001) 40% = -.232(.0003)
10% = -.131(.04) 50% = -.188(.003)
20% = -.180(.005) 80% = -.141(.03)
30% = -.171(.008)

latewood percent : 40% = .157(.014)
60% = .172(.007)
80% = .153(.017)

earlywood angle : 0% = -.192(.003) 40% = -.176(.006)
10% = -.211(.001) 50% = -.175(.006)
20% = -.210(.001) 80% = -.139(.03)
30% = -.257(.0001)

LWTCD : 0% = .191(.003)
10% = .158(.014)
20% = .151(.019)

LWRWT : 0% = .241(.0002) 60% = .127(.048)
10% = .127(.048) 70% = .204(.001)
40% = .190(.003) 80% = .134(.037)
50% = .201(.002)

LWRCD : 0% = .181(.005) 30% = .173(.007)
10% = .186(.004) 40% = .160(.012)
20% = .129(.04) 70% = .166(.01)

LWRLD : 0% = .142(.027) 40% = .127(.047)
10% = .141(.028) 70% = .133(.038)
30% = .172(.007)

LWTWT : 90% = .210(.001)

EWRCD : 0% = .165(.01)
20% = .171(.008)

EWTLD : 0% = .129(.045)
20% = .157(.014)

EWRWT : 0% = .168(.009) 70% = .192(.003)
40% = .154(.016) 80% = .132(.04)

EWRCD : 0% = .207(.001)
10% = .144(.024)
20% = .194(.002)

EWRLD : 0% = .176(.006)
20% = .177(.006)

EWTWT : 0% = .138(.031) 70% = .187(.004)
10% = .136(.034) 80% = .129(.04)
40% = .172(.007) 90% = .136(.03)

5. stemwood specific gravity

with latewood length : 10% = -.148(.02)

latewood angle : 0% = .153(.017) 40% = .169(.008)
10% = .174(.007) 50% = .186(.004)
20% = .190(.003) 90% = .150(.019)
30% = .197(.002)

resin canal number : 50% = .149(.02)

earlywood length : 10% = -.149(.02)

earlywood angle : 10% = .143(.03)
30% = .217(.001)
50% = .140(.03)

LWTCD : 10% = -.173(.007)
20% = -.179(.005)
30% = -.127(.048)

LWTLD : 10% = -.131(.041)

LWRWT : 0% = -.137(.03) 40% = -.162(.01)
20% = -.186(.004) 50% = -.169(.008)

LWRCD : 10% = -.204(.001) 40% = -.160(.01)
20% = -.170(.008) 70% = -.136(.03)
30% = -.159(.013)

LWRLD : 10% = -.156(.015) 40% = -.129(.045)
30% = -.158(.014) 70% = -.152(.018)

LWTWT : 20% = -.138(.03)
90% = -.157(.015)

EWRWT : 0% = -.162(.01)
20% = -.151(.02)
40% = -.168(.009)

EWTWT : 20% = -.140(.03)

6. stemwood diameter, mm

with latewood length : 90% = .18(.005)

latewood percent : 10% = .133(.038)

resin canal number : 70% = -.151(.018)

earlywood length : 20% = .158(.014)
90% = .146(.023)

LWTCD : 30% = .128(.046)
50% = .135(.035)
80% = .130(.04)

LWTLD : 70% = .131(.04)
80% = .135(.035)

LWRWT : 50% = .145(.024)

EWTCD : 80% = .19(.003)

EWTLD : 80% = .185(.004)

EWRCD : 40% = .14(.029) 80% = .185(.004)
60% = .132(.039) 90% = .168(.009)

EWRLD : 40% = .164(.01)
80% = .185(.004)
90% = .17(.008)

EWTWT : 50% = .129(.045)

7. pith eccentricity, mm

with latewood angle : 70% = .13(.041)

resin canal number : 0% = .128(.046)

resin canal diameter : 90% = -.15(.019)

earlywood angle : 90% = .155(.016)

LWTCD : 30% = .154(.016)
60% = .143(.025)

LWTLD : 30% = .163(.01)
60% = .148(.02)

LWRWT : 70% = -.169(.008)
90% = -.137(.03)

LWTWT : 70% = -.142(.027)

EWRWT : 0% = .137(.03)

EWRCD : 60% = .134(.037)

EWRLD : 60% = .135(.035)
90% = .141(.028)

EWTWT : 30% = -.129(.045)
40% = -.143(.026)
90% = -.137(.033)

8. stemwood volumetric percentage of compression wood

with latewood length : 20% = -.141(.028)
30% = -.127(.049)
70% = -.143(.026)

latewood angle : 20% = .141(.028)
30% = .13(.042)
90% = .169(.008)

resin canal number : 70% = .179(.005)

earlywood length : 60% = -.133(.038)
70% = -.131(.042)
90% = -.134(.037)

earlywood angle : 30% = .139(.03)
90% = .196(.002)

LWRWT : 90% = -.135(.035)

LWRCD : 60% = -.142(.027)

LWTWT : 30% = .137(.033)

EWRWT : 60% = -.147(.022)
70% = -.144(.025)

9. stemwood out-of-roundness index

with latewood angle : 40% = -.14(.029) 60% = -.147(.02)
50% = -.128(.047) 90% = -.142(.027)

latewood percent : 90% = .169(.008)

earlywood angle : 20% = -.135(.036) 70% = -.146(.023)
40% = -.169(.009) 90% = -.166(.009)
50% = -.157(.015)

LWTCD : 0% = -.139(.03)

LWTLD : 0% = -.146(.023)

LWRWT : 60% = .149(.02)

LWRCD : 80% = -.128(.047)

LWRLD : 0% = -.132(.04)

LWTWT : 90% = .131(.04)

CORRELATIONS BY HEIGHT -- MURRAYANA (n=36)

only correlations significant at the 5% level are reported here;
the Pearson correlation is given with the p-value in parentheses

1. stem bark thickness, mm

   with latewood percent : 20% of bole height = -.391(.018)

   LWTCD : 10% = .402(.015)
           20% = .411(.013)

   LWTLD : 20% = .346(.039)

   LWRCD : 10% = .505(.002)
           20% = .343(.04)

   LWRLD : 10% = .534(.001)
           20% = .397(.016)

   LWTWT : 60% = -.40(.016)

2. stem bark specific gravity

   with latewood length : 20% = -.424(.01)
                          50% = -.372(.026)
                          60% = -.382(.022)

   latewood angle : 20% = .341(.04)
                    40% = .543(.001)

   LWTCD : 80% = .387(.02)

   LWTLD : 80% = .390(.02)

   LWRCD : 80% = .389(.02)

   LWRLD : 80% = .354(.03)

   EWTCD : 40% = -.365(.03)
           90% = -.427(.01)

   EWTLD : 40% = -.394(.02)
           90% = -.407(.01)

   EWTWT : 20% = -.338(.04)

3. stem bark moisture content, %

   with latewood length : 10% = .426(.01) 30% = .358(.03)
                          20% = .389(.02) 50% = .397(.02)

   latewood angle : 40% = -.462(.005)
                    70% = -.368(.03)

   earlywood angle : 10% = -.351(.036)

   LWTCD : 80% = -.338(.044)

   LWTLD : 80% = -.348(.038)

LWRWT : 50% = .455(.005)

LWRCD : 80% = -.414(.012)

LWRLD : 80% = -.377(.024)

EWTCD : 0% = .447(.006) 50% = .339(.043)
20% = .357(.03) 90% = .454(.005)
40% = .392(.018)

EWTLD : 0% = .465(.004) 40% = .415(.012)
20% = .347(.038) 90% = .405(.014)

EWRCD : 0% = .461(.005)
90% = .351(.036)

EWRLD : 0% = .470(.004)

EWTWT : 50% = .391(.018)

4. stemwood moisture content, %

with latewood length : 10% = .387(.02) 50% = .334(.047)
20% = .412(.01) 60% = .390(.019)

latewood angle : 20% = -.332(.048)

LWTCD : 60% = .348(.037)

LWTLD : 60% = .335(.046)

LWRWT : 80% = -.458(.005)

EWTLD : 60% = .359(.032)

5. stemwood specific gravity

with latewood length : 20% = -.348(.038)

latewood angle : 10% = .342(.04)
20% = .401(.015)

latewood percent : 0% = .368(.027)
20% = .396(.017)

earlywood length : 0% = -.391(.018)

LWRWT : 80% = .402(.015)

EWTWT : 0% = .401(.016)

6. stemwood diameter, mm

with latewood percent : 20% = -.436(.008)

LWTCD : 10% = .355(.034)
20% = .353(.034)

LWTLD : 10% = .332(.048)

LWRWT : 50% = -.372(.026)

9. stemwood out-of-roundness index

with latewood length : 80% = -.336(.045)

resin canal number : 0% = .419(.01)

LWRWT : 80% = -.449(.006)

LWRCD : 70% = .358(.032)

LWTWT : 10% = -.392(.018)

LWRCD : 10% = .362(.03)

LWRLD : 10% = .407(.014)
20% = .393(.018)

EWTWT : 50% = -.411(.013)

7. pith eccentricity, mm

with resin canal diameter : 0% = -.375(.024)

LWTCD : 0% = .346(.038)
10% = .352(.036)

LWTLD : 0% = .338(.044)
40% = .35(.037)

LWRCD : 0% = .395(.017)
10% = .387(.02)
40% = .374(.025)

LWRLD : 0% = .333(.047)
10% = .367(.028)
40% = .403(.015)

EWRCD : 0% = .387(.02)

EWRLD : 0% = .35(.036)

EWTWT : 10% = .333(.047)

8. stemwood volumetric percentage of compression wood

with resin canal number : 30% = .44(.007)
40% = .356(.03)

earlywood length : 20% = .346(.039)

LWTCD : 20% = -.412(.012)
40% = -.384(.02)
70% = -.36(.03)

LWTLD : 20% = -.35(.036)
40% = -.372(.026)
70% = -.349(.037)
80% = -.358(.032)

EWRWT : 80% = .452(.006)

EWRCD : 0% = .363(.03)
30% = .334(.046)

EWRLD : 0% = .346(.039)

CORRELATIONS BY HEIGHT -- ALL SECTIONS OF THE TREES

each of the 2430 (243 trees x 10 heights) LATIFOLIA sections was correlated -- and each of the 360 MURRAYANA sections similarly correlated -- with each section's other properties

the Pearson correlation is reported if the correlation is significant at the 5% level -- otherwise "ns" is inserted for "not significant"

LATEWOOD FIBER LENGTH with

	LATIFOLIA	MURRAYANA
1. stem bark thickness, mm	.053	ns
2. stem bark specific gravity	ns	ns
3. stem bark moisture content, %	-.064	ns
4. stemwood moisture content, %	-.076	ns
5. stemwood specific gravity	-.048	ns
6. stemwood diameter, mm	.136	ns
7. pith eccentricity, mm	.068	ns
8. stemwood volumetric percentage of compression wood	-.097	.109
9. stemwood out-of-roundness index	.063	ns

LATEWOOD MICROFIBRIL ANGLE with

	LATIFOLIA	MURRAYANA
1. stem bark thickness, mm	ns	-.141
2. stem bark specific gravity	.107	.141
3. stem bark moisture content, %	-.073	-.133
4. stemwood moisture content, %	-.121	-.106
5. stemwood specific gravity	.126	.198
6. stemwood diameter, mm	ns	ns
7. pith eccentricity, mm	ns	ns
8. stemwood volumetric percentage of compression wood	.067	ns
9. stemwood out-of-roundness index	-.096	ns

LATEWOOD PERCENTAGE with

	LATIFOLIA	MURRAYANA
1. stem bark thickness, mm	.136	ns
2. stem bark specific gravity	.137	.232
3. stem bark moisture content, %	-.200	-.266
4. stemwood moisture content, %	-.096	-.280
5. stemwood specific gravity	.067	.290
6. stemwood diameter, mm	.246	.142
7. pith eccentricity, mm	.162	.156
8. stemwood volumetric percentage of compression wood	ns	ns
9. stemwood out-of-roundness index	.085	ns

RESIN CANAL NUMBER with

	LATIFOLIA	MURRAYANA
1. stem bark thickness, mm	ns	-.156
2. stem bark specific gravity	ns	-.149
3. stem bark moisture content, %	.050	.163
4. stemwood moisture content, %	ns	ns
5. stemwood specific gravity	ns	ns
6. stemwood diameter, mm	ns	-.158
7. pith eccentricity, mm	ns	-.145
8. stemwood volumetric percentage of compression wood	ns	ns
9. stemwood out-of-roundness index	ns	ns

RESIN CANAL DIAMETER with

	LATIFOLIA	MURRAYANA
1. stem bark thickness, mm	-.086	-.137
2. stem bark specific gravity	-.094	ns
3. stem bark moisture content, %	.080	ns
4. stemwood moisture content, %	ns	.131
5. stemwood specific gravity	ns	ns
6. stemwood diameter, mm	-.049	ns
7. pith eccentricity, mm	-.059	-.131
8. stemwood volumetric percentage of compression wood	ns	-.109
9. stemwood out-of-roundness index	.048	ns

EARLYWOOD FIBER LENGTH with

	LATIFOLIA	MURRAYANA
1. stem bark thickness, mm	.046	ns
2. stem bark specific gravity	-.067	ns
3. stem bark moisture content, %	ns	ns
4. stemwood moisture content, %	ns	.148
5. stemwood specific gravity	-.064	-.199
6. stemwood diameter, mm	.124	ns
7. pith eccentricity, mm	.046	ns
8. stemwood volumetric percentage of compression wood	-.092	ns
9. stemwood out-of-roundness index	.083	ns

EARLYWOOD MICROFIBRIL ANGLE with

	LATIFOLIA	MURRAYANA
1. stem bark thickness, mm	ns	ns
2. stem bark specific gravity	.102	.116
3. stem bark moisture content, %	-.093	ns
4. stemwood moisture content, %	-.126	ns
5. stemwood specific gravity	.081	.133
6. stemwood diameter, mm	-.040	ns
7. pith eccentricity, mm	ns	ns
8. stemwood volumetric percentage of compression wood	.060	ns
9. stemwood out-of-roundness index	-.092	ns

LATEWOOD TANGENTIAL CELL DIAMETER with

	LATIFOLIA	MURRAYANA
1. stem bark thickness, mm	.047	.133
2. stem bark specific gravity	ns	ns
3. stem bark moisture content, %	ns	ns
4. stemwood moisture content, %	.055	.242
5. stemwood specific gravity	-.100	ns
6. stemwood diameter, mm	.069	ns
7. pith eccentricity, mm	.058	ns
8. stemwood volumetric percentage of compression wood	ns	-.204
9. stemwood out-of-roundness index	ns	ns

LATEWOOD TANGENTIAL LUMEN DIAMETER with

	LATIFOLIA	MURRAYANA
1. stem bark thickness, mm	ns	ns
2. stem bark specific gravity	ns	ns
3. stem bark moisture content, %	ns	ns
4. stemwood moisture content, %	.075	.216
5. stemwood specific gravity	-.098	-.106
6. stemwood diameter, mm	ns	ns
7. pith eccentricity, mm	ns	ns
8. stemwood volumetric percentage of compression wood	ns	-.210
9. stemwood out-of-roundness index	-.068	ns

LATEWOOD RADIAL.. WALL THICKNESS with

	LATIFOLIA	MURRAYANA
1. stem bark thickness, mm	.128	.131
2. stem bark specific gravity	.053	ns
3. stem bark moisture content, %	-.158	ns
4. stemwood moisture content, %	-.060	ns
5. stemwood specific gravity	ns	ns
6. stemwood diameter, mm	.243	ns
7. pith eccentricity, mm	.122	ns
8. stemwood volumetric percentage of compression wood	ns	ns
9. stemwood out-of-roundness index	.128	ns

LATEWOOD RADIAL CELL DIAMETER with

	LATIFOLIA	MURRAYANA
1. stem bark thickness, mm	.044	ns
2. stem bark specific gravity	ns	ns
3. stem bark moisture content, %	ns	ns
4. stemwood moisture content, %	.081	.144
5. stemwood specific gravity	-.088	ns
6. stemwood diameter, mm	.059	ns
7. pith eccentricity, mm	.041	ns
8. stemwood volumetric percentage of compression wood	ns	-.116
9. stemwood out-of-roundness index	ns	ns

LATEWOOD RADIAL LUMEN DIAMETER with

	LATIFOLIA	MURRAYANA
1. stem bark thickness, mm	ns	.115
2. stem bark specific gravity	ns	ns
3. stem bark moisture content, %	ns	ns
4. stemwood moisture content, %	.100	.165
5. stemwood specific gravity	-.089	-.108
6. stemwood diameter, mm	ns	ns
7. pith eccentricity, mm	ns	ns
8. stemwood volumetric percentage of compression wood	ns	-.116
9. stemwood out-of-roundness index	-.045	ns

LATEWOOD TANG. WALL THICKNESS with

	LATIFOLIA	MURRAYANA
1. stem bark thickness, mm	.054	ns
2. stem bark specific gravity	ns	ns
3. stem bark moisture content, %	-.116	ns
4. stemwood moisture content, %	-.077	ns
5. stemwood specific gravity	ns	.119
6. stemwood diameter, mm	.170	ns
7. pith eccentricity, mm	.090	ns
8. stemwood volumetric percentage of compression wood	ns	ns
9. stemwood out-of-roundness index	.096	ns

EARLYWOOD TANGENTIAL CELL DIAMETER with

	LATIFOLIA	MURRAYANA
1. stem bark thickness, mm	ns	ns
2. stem bark specific gravity	-.044	-.201
3. stem bark moisture content, %	ns	.270
4. stemwood moisture content, %	.048	.192
5. stemwood specific gravity	-.052	ns
6. stemwood diameter, mm	.058	ns
7. pith eccentricity, mm	ns	ns
8. stemwood volumetric percentage of compression wood	ns	ns
9. stemwood out-of-roundness index	ns	ns

EARLYWOOD TANGENTIAL LUMEN DIAMETER with

	LATIFOLIA	MURRAYANA
1. stem bark thickness, mm	ns	ns
2. stem bark specific gravity	-.040	-.192
3. stem bark moisture content, %	.043	.259
4. stemwood moisture content, %	.051	.198
5. stemwood specific gravity	-.047	ns
6. stemwood diameter, mm	ns	ns
7. pith eccentricity, mm	ns	ns
8. stemwood volumetric percentage of compression wood	ns	ns
9. stemwood out-of-roundness index	ns	ns

EARLYWOOD RADIAL WALL THICKNESS with

	LATIFOLIA	MURRAYANA
1. stem bark thickness, mm	.063	ns
2. stem bark specific gravity	ns	ns
3. stem bark moisture content, %	-.071	ns
4. stemwood moisture content, %	ns	ns
5. stemwood specific gravity	ns	ns
6. stemwood diameter, mm	.164	ns
7. pith eccentricity, mm	.082	ns
8. stemwood volumetric percentage of compression wood	ns	ns
9. stemwood out-of-roundness index	.076	ns

EARLYWOOD RADIAL CELL DIAMETER with

	LATIFOLIA	MURRAYANA
1. stem bark thickness, mm	.043	ns
2. stem bark specific gravity	ns	-.119
3. stem bark moisture content, %	ns	.211
4. stemwood moisture content, %	.054	.140
5. stemwood specific gravity	-.072	ns
6. stemwood diameter, mm	.082	ns
7. pith eccentricity, mm	.055	ns
8. stemwood volumetric percentage of compression wood	ns	ns
9. stemwood out-of-roundness index	ns	ns

EARLYWOOD RADIAL LUMEN DIAMETER with

	LATIFOLIA	MURRAYANA
1. stem bark thickness, mm	.037	ns
2. stem bark specific gravity	ns	-.110
3. stem bark moisture content, %	ns	.199
4. stemwood moisture content, %	.056	.149
5. stemwood specific gravity	-.071	ns
6. stemwood diameter, mm	.057	ns
7. pith eccentricity, mm	.045	ns
8. stemwood volumetric percentage of compression wood	ns	ns
9. stemwood out-of-roundness index	ns	ns

EARLYWOOD TANG. WALL THICKNESS with

	LATIFOLIA	MURRAYANA
1. stem bark thickness, mm	ns	ns
2. stem bark specific gravity	ns	ns
3. stem bark moisture content, %	-.050	ns
4. stemwood moisture content, %	ns	ns
5. stemwood specific gravity	ns	ns
6. stemwood diameter, mm	.123	ns
7. pith eccentricity, mm	.050	ns
8. stemwood volumetric percentage of compression wood	ns	ns
9. stemwood out-of-roundness index	.066	ns

PHASE 2: TREE-AVERAGE ANALYSIS
EARLYWOOD AND LATEWOOD COMBINED AS IN PULPING

Tree average wood and cell property values with earlywood and latewood combined for var. murrayana, and var. latifolia are reported in this section. Results are summarized in the listing of ANOVA results.

TREE-AVERAGE ANALYSIS FOR LATIFOLIA/STEMWOOD

This section presents the results from analysis of variance with latewood and earlywood mixed together as in pulping. Results are presented for 11 variables and the necessary summary tables follow. If there were no significant differences, the pooled values are given here. All tests were done at the 5% level.

1. FIBER LENGTH

   the LxExD, ExD, LxD and LxE interactions were significant

2. MICROFIBRIL ANGLE

   the LxExD, ExD and LxE interactions were significant

3. LATEWOOD PERCENTAGE

   the latitude means were significantly different

4. RESIN CANAL NUMBER

   the latitude means were significantly different

5. RESIN CANAL DIAMETER

   there were no significant differences -- pooled values are
   ave = 71.91
   std = 4.94 (range : 58.7 - 83.3)

6. TANGENTIAL CELL DIAMETER

   the latitude means were significantly different

7. TANGENTIAL LUMEN DIAMETER

   there were no significant differences -- pooled values are
   ave = 27.82
   std = 3.2 (range : 19.0 - 41.2)

8. RADIAL WALL THICKNESS

   the LxExD interaction was significant

9. RADIAL CELL DIAMETER

   the latitude means were significantly different

10. RADIAL LUMEN DIAMETER

    there were no significant differences -- pooled values are
    ave = 29.69
    std = 3.36 (range : 18.9 - 43.0)

11. TANG. WALL THICKNESS

    the latitude means were significantly different

SUMMARIES BY LATITUDE -- LATIFOLIA/STEMWOOD

LAT	LATEWOOD PERCENTAGE	RESIN CANAL NUMBER
40	15.31(2.35) 10.2-19.7	35.59(5.69) 25.4-50.6
42.5	15.79(2.64) 10.2-20.8	36.60(5.56) 25.8-45.9
45	15.93(3.17) 10.1-22.4	35.11(5.75) 23.1-47.8
47.5	15.94(2.78) 10.8-20.3	40.28(7.04) 26.8-54.4
50	14.6(2.28) 9.6-18.7	37.1(5.07) 26.7-47.9
52.5	15.77(2.05) 12.0-19.2	37.15(4.18) 28.0-50.3
55	14.74(1.8) 11.9-18.5	37.51(3.63) 32.3-46.2
57.5	12.24(1.46) 8.5-14.9	36.04(4.85) 23.0-47.2
60	12.59(1.78) 9.7-18.0	40.31(6.35) 27.7-50.6

LAT	TANG.CELL DIAMETER	RADIAL CELL DIAMETER
40	34.04(3.28) 28.7-41.6	34.92(3.08) 29.9-42.1
42.5	33.94(2.94) 29.0-38.9	34.72(3.09) 30.7-40.2
45	34.0(2.33) 30.1-38.5	34.33(2.54) 30.8-39.1
47.5	33.32(2.35) 27.2-37.6	34.1(2.9) 28.0-38.96
50	34.05(4.32) 24.7-46.5	34.72(4.52) 25.6-46.98
52.5	31.09(3.57) 23.97-39.5	31.81(3.38) 23.96-39.5
55	33.59(2.14) 28.7-36.5	33.72(2.06) 29.3-37.7
57.5	32.37(3.72) 26.1-38.9	32.9(4.43) 23.5-40.0
60	33.4(2.16) 30.3-39.2	33.65(2.25) 30.1-38.3

LAT	TANG. WALL THICKNESS
40	2.09(0.30) 1.5-2.6
42.5	2.15(0.30) 1.3-2.6
45	2.2(0.23) 1.7-2.5
47.5	2.23(0.23) 1.7-2.8
50	2.06(0.21) 1.7-2.5
52.5	1.91(0.23) 1.4-2.4
55	2.02(0.18) 1.6-2.3
57.5	1.99(0.35) 1.1-2.6
60	1.95(0.24) 1.4-2.3

SUMMARIES BY LAT, ELEV AND DIAM -- LATIFOLIA/STEMWOOD

FIBER LENGTH

ELEV	76 mm	152 mm	228 mm	All trees
		40 degrees lat		
low	1.82(0.35) 1.6-2.2	3.07(0.31) 2.8-3.4	2.16(0.12) 2.0-2.3	2.35(0.61) 1.6-3.4
med	2.19(0.41) 1.7-2.5	3.46(0.14) 3.3-3.6	2.52(0.45) 2.2-3.0	2.72(0.65) 1.7-3.6
high	1.87(0.08) 1.8-1.9	3.49(0.09) 3.4-3.6	2.11(0.46) 1.8-2.6	2.49(0.79) 1.8-3.6
		42.5 degrees lat		
low	1.7(0.20) 1.5-1.9	1.94(0.10) 1.8-2.0	1.78(0.19) 1.6-2.0	1.81(0.18) 1.5-2.0
med	1.86(0.13) 1.7-2.0	2.91(0.10) 2.8-3.0	1.82(0.12) 1.7-2.0	2.20(0.54) 1.7-3.0
high	1.75(0.05) 1.7-1.8	1.98(0.06) 1.9-2.1	1.48(0.16) 1.3-1.6	1.74(0.24) 1.3-2.1
		45 degrees lat		
low	2.08(0.07) 2.0-2.2	2.24(0.19) 2.0-2.4	2.63(0.44) 2.2-3.0	2.32(0.34) 2.0-3.0
med	2.63(0.27) 2.3-2.9	2.85(0.35) 2.6-3.3	2.22(0.68) 1.6-2.9	2.57(0.49) 1.6-3.3
high	1.62(0.01) 1.61-1.63	2.37(0.24) 2.2-2.6	2.24(0.45) 1.7-2.5	2.08(0.43) 1.6-2.6
		47.5 degrees lat		
low	1.89(0.08) 1.8-2.0	1.77(0.13) 1.7-1.9	2.36(0.09) 2.3-2.5	2.01(0.28) 1.7-2.5
med	1.86(0.12) 1.7-2.0	2.26(0.20) 2.1-2.5	2.23(0.22) 2.0-2.5	2.12(0.25) 1.7-2.5
high	1.71(0.18) 1.6-1.9	2.0(0.07) 1.9-2.1	1.84(0.09) 1.8-1.9	1.85(0.17) 1.6-2.1
		50 degrees lat		
low	3.33(0.26) 3.1-3.6	2.82(0.38) 2.5-3.2	2.68(0.50) 2.1-3.0	2.94(0.45) 2.1-3.6
med	2.01(0.28) 1.7-2.2	2.56(0.16) 2.4-2.7	2.01(0.15) 1.9-2.2	2.19(0.33) 1.7-2.7
high	2.27(0.19) 2.1-2.5	2.79(0.51) 2.2-3.3	2.7(0.44) 2.3-3.2	2.59(0.43) 2.1-3.3

ELEV	76 mm	152 mm	228 mm	All trees
		52.5 degrees lat		
low	1.54(0.09) 1.5-1.6	1.79(0.11) 1.7-1.9	1.78(0.05) 1.75-1.84	1.71(0.14) 1.5-1.9
med	2.04(0.35) 1.8-2.4	2.01(0.03) 1.98-2.04	1.81(0.06) 1.75-1.86	1.95(0.21) 1.8-2.4
high	1.67(0.28) 1.4-1.9	1.86(0.08) 1.8-1.9	1.43(0.29) 1.2-1.7	1.65(0.27) 1.2-1.9
		55 degrees lat		
low	1.88(0.08) 1.8-2.0	1.74(0.13) 1.6-1.9	2.02(0.39) 1.7-2.5	1.88(0.24) 1.6-2.5
med	1.78(0.08) 1.7-1.9	1.89(0.29) 1.6-2.1	1.53(0.18) 1.3-1.7	1.73(0.24) 1.3-2.1
high	1.81(0.07) 1.7-1.9	1.83(0.16) 1.7-2.0	2.24(0.31) 2.0-2.6	1.96(0.28) 1.7-2.6
		57.5 degrees lat		
low	3.04(0.22) 2.8-3.2	3.1(0.44) 2.6-3.5	3.48(0.11) 3.4-3.6	3.21(0.32) 2.6-3.6
med	2.11(0.30) 1.9-2.5	2.71(0.60) 2.1-3.2	2.9(0.67) 2.2-3.5	2.57(0.59) 1.9-3.5
high	2.59(0.32) 2.2-2.8	2.44(0.32) 2.1-2.8	2.78(0.46) 2.3-3.2	2.61(0.36) 2.1-3.2
		60 degrees lat		
low	1.94(0.04) 1.89-1.97	2.21(0.24) 2.0-2.5	2.19(0.05) 2.14-2.24	2.11(0.18) 1.89-2.5
med	1.88(0.06) 1.8-1.9	2.28(0.12) 2.2-2.4	2.14(0.15) 2.0-2.3	2.1(0.20) 1.8-2.4
high	1.83(0.12) 1.7-2.0	2.21(0.06) 2.2-2.3	1.85(0.10) 1.8-2.0	1.96(0.21) 1.7-2.3
pooled	2.03(0.45) 1.4-3.6	2.39(0.55) 1.6-3.6	2.18(0.54) 1.2-3.6	2.2(0.54) 1.2-3.6

SUMMARIES BY LAT, ELEV AND DIAM -- LATIFOLIA/STEMWOOD

MICROFIBRIL ANGLE

ELEV	76 mm	152 mm	228 mm	All trees
		40 degrees lat		
low	25.56(1.0) 24.6-26.6	30.43(1.12) 29.1-31.2	23.98(1.08) 22.9-25.0	26.66(3.06) 22.9-31.2
med	19.37(1.28) 18.3-20.8	21.43(1.68) 19.7-23.1	20.09(0.60) 19.4-20.5	20.3(1.42) 18.3-23.1
high	21.1(1.57) 19.6-22.8	19.38(3.24) 15.8-22.0	22.63(3.66) 18.4-25.1	21.04(2.93) 15.8-25.1
		42.5 degrees lat		
low	27.23(2.14) 25.0-29.3	28.48(2.4) 25.8-30.3	30.81(2.21) 28.4-32.8	28.84(2.51) 25.0-32.8
med	25.18(1.81) 23.6-27.2	31.85(2.11) 29.6-33.7	23.43(3.5) 19.4-25.6	26.82(4.45) 19.4-33.7
high	23.03(2.06) 21.4-25.4	22.67(0.57) 22.1-23.2	24.35(1.24) 23.0-25.5	23.35(1.45) 21.4-25.5
		45 degrees lat		
low	25.82(0.61) 25.1-26.2	27.79(1.08) 27.0-29.0	25.52(3.76) 21.4-28.6	26.37(2.25) 21.4-29.0
med	18.04(0.41) 17.7-18.5	18.47(0.34) 18.2-18.8	17.71(1.79) 16.5-19.8	18.07(0.99) 16.5-19.8
high	22.28(1.67) 21.1-24.2	22.27(4.27) 17.4-25.0	20.96(1.25) 19.6-22.0	21.84(2.47) 17.4-25.0
		47.5 degrees lat		
low	25.85(1.31) 25.0-27.4	22.2(3.87) 19.8-26.7	27.08(1.46) 25.4-28.0	25.05(3.09) 19.8-28.0
med	24.26(1.33) 22.9-25.6	27.61(1.77) 25.7-29.2	26.07(1.79) 24.6-28.1	25.98(2.03) 22.9-29.2
high	23.48(5.1) 19.5-29.2	23.82(3.2) 21.6-27.5	25.76(2.3) 23.9-28.3	24.36(3.4) 19.5-29.2
		50 degrees lat		
low	19.32(1.67) 18.3-21.3	19.81(2.83) 17.9-23.1	17.45(1.68) 15.7-19.0	18.86(2.14) 15.7-23.1
med	24.24(2.4) 22.3-26.9	23.61(1.34) 22.5-25.1	20.42(0.76) 19.6-21.0	22.76(2.28) 19.6-26.9
high	21.28(0.73) 20.7-22.1	28.39(1.54) 27.5-30.2	27.89(4.31) 23.3-31.9	25.85(4.15) 20.7-31.9

ELEV	76 mm	152 mm	228 mm	All trees
		52.5 degrees lat		
low	32.66(5.3) 28.9-38.7	36.16(1.37) 35.2-37.7	34.33(1.55) 32.6-35.7	34.38(3.23) 28.9-38.7
med	38.54(5.88) 31.8-41.9	35.86(2.16) 33.6-37.9	28.76(0.36) 28.4-29.1	34.39(5.38) 28.4-41.9
high	34.1(0.60) 33.7-34.8	35.86(5.51) 32.6-42.2	30.68(2.0) 29.5-33.0	33.55(3.73) 29.5-42.2
		55 degrees lat		
low	23.62(0.74) 22.8-24.3	21.01(0.87) 20.0-21.6	23.87(3.69) 20.2-27.6	22.83(2.37) 20.0-27.6
med	24.9(1.53) 23.7-26.6	26.07(3.12) 24.0-29.7	24.6(2.32) 22.2-26.8	25.19(2.19) 22.2-29.7
high	26.13(3.32) 22.4-28.6	25.66(2.43) 23.0-27.7	26.56(1.9) 25.4-28.8	26.12(2.3) 22.4-28.8
		57.5 degrees lat		
low	33.55(4.1) 30.6-38.2	28.35(1.08) 27.4-29.5	27.88(2.07) 25.5-29.1	29.93(3.61) 25.5-38.2
med	24.61(0.57) 24.3-25.3	29.62(8.16) 24.0-39.0	22.77(1.59) 21.1-24.3	25.67(5.17) 21.1-39.0
high	28.79(0.46) 28.4-29.3	26.66(1.43) 25.0-27.7	31.84(0.87) 31.0-32.7	29.1(2.41) 25.0-32.7
		60 degrees lat		
low	35.62(3.87) 31.4-39.0	35.53(2.01) 33.4-37.4	33.87(4.6) 28.7-37.6	35.01(3.28) 28.7-39.0
med	38.89(0.89) 37.9-39.7	42.85(4.07) 38.2-45.2	40.97(1.17) 39.7-42.0	40.9(2.76) 37.9-45.2
high	35.84(4.48) 31.2-40.2	31.34(7.27) 23.3-37.4	26.23(4.86) 22.4-31.7	31.14(6.44) 22.4-40.2
pooled	26.79(6.25) 17.7-41.9	27.53(6.57) 15.8-45.2	26.17(5.6) 15.7-42.0	26.83(6.15) 15.7-45.2

SUMMARIES BY LAT, ELEV AND DIAM -- LATIFOLIA/STEMWOOD

RADIAL WALL THICKNESS

ELEV	76 mm	152 mm	228 mm	All trees
		40 degrees lat		
low	2.57(0.21) 2.4-2.8	2.5(0.44) 2.2-3.0	2.83(0.15) 2.7-3.0	2.63(0.30) 2.2-3.0
med	2.87(0.21) 2.7-3.1	2.87(0.32) 2.5-3.1	2.27(0.32) 1.9-2.5	2.67(0.39) 1.9-3.1
high	2.83(0.21) 2.6-3.0	3.03(0.23) 2.9-3.3	2.33(0.06) 2.3-2.4	2.73(0.35) 2.3-3.3
		42.5 degrees lat		
low	2.13(0.29) 1.8-2.3	2.83(0.31) 2.5-3.1	3.07(0.29) 2.9-3.4	2.68(0.49) 1.8-3.4
med	2.7(0.61) 2.0-3.1	2.6(0.20) 2.4-2.8	3.07(0.35) 2.7-3.4	2.79(0.42) 2.0-3.4
high	2.9(0.44) 2.4-3.2	3.1(0.0) 3.1-3.1	3.03(0.06) 3.0-3.1	3.01(0.24) 2.4-3.2
		45 degrees lat		
low	3.03(0.57) 2.4-3.5	2.87(0.15) 2.7-3.0	2.73(0.32) 2.5-3.1	2.88(0.36) 2.4-3.5
med	2.8(0.27) 2.5-3.0	2.73(0.23) 2.6-3.0	3.0(0.0) 3.0-3.0	2.84(0.21) 2.5-3.0
high	2.8(0.20) 2.6-3.0	2.73(0.40) 2.5-3.2	2.77(0.15) 2.6-2.9	2.77(0.24) 2.5-3.2
		47.5 degrees lat		
low	2.83(0.32) 2.6-3.2	2.93(0.23) 2.8-3.2	2.63(0.21) 2.4-2.8	2.8(0.26) 2.4-3.2
med	2.63(0.21) 2.4-2.8	2.67(0.55) 2.1-3.2	2.83(0.06) 2.8-2.9	2.71(0.31) 2.1-3.2
high	2.77(0.15) 2.6-2.9	2.9(0.27) 2.6-3.1	3.33(0.64) 2.6-3.7	3.0(0.44) 2.6-3.7
		50 degrees lat		
low	2.9(0.20) 2.7-3.1	2.5(0.10) 2.4-2.6	2.77(0.15) 2.6-2.9	2.72(0.22) 2.4-3.1
med	2.7(0.40) 2.3-3.1	2.7(0.17) 2.5-2.8	2.87(0.29) 2.7-3.2	2.76(0.27) 2.3-3.2
high	2.57(0.06) 2.5-2.6	2.27(0.21) 2.1-2.5	2.63(0.06) 2.6-2.7	2.49(0.20) 2.1-2.7

ELEV	76 mm	152 mm	228 mm	All trees
		52.5 degrees lat		
low	2.77(0.35) 2.4-3.1	2.27(0.32) 1.9-2.5	2.57(0.15) 2.4-2.7	2.53(0.33) 1.9-3.1
med	2.53(0.06) 2.5-2.6	2.67(0.15) 2.5-2.8	2.47(0.21) 2.3-2.7	2.56(0.16) 2.3-2.8
high	2.4(0.27) 2.1-2.6	2.3(0.20) 2.1-2.5	2.63(0.40) 2.2-3.0	2.44(0.30) 2.1-3.0
		55 degrees lat		
low	2.63(0.40) 2.2-3.0	2.67(0.15) 2.5-2.8	2.4(0.30) 2.1-2.7	2.57(0.29) 2.1-3.0
med	2.6(0.17) 2.4-2.7	2.47(0.15) 2.3-2.6	2.83(0.32) 2.6-3.2	2.63(0.26) 2.3-3.2
high	2.57(0.25) 2.3-2.8	2.67(0.15) 2.5-2.8	2.5(0.10) 2.4-2.6	2.58(0.17) 2.3-2.8
		57.5 degrees lat		
low	2.37(0.50) 1.9-2.9	2.83(0.21) 2.6-3.0	2.87(0.31) 2.6-3.2	2.69(0.40) 1.9-3.2
med	2.93(0.25) 2.7-3.2	2.23(0.74) 1.4-2.8	2.5(0.56) 2.0-3.1	2.56(0.57) 1.4-3.2
high	2.5(0.17) 2.4-2.7	2.67(0.40) 2.3-3.1	2.7(0.10) 2.6-2.8	2.62(0.24) 2.3-3.1
		60 degrees lat		
low	2.77(0.64) 2.4-3.5	2.67(0.15) 2.5-2.8	2.67(0.12) 2.6-2.8	2.7(0.34) 2.4-3.5
med	2.63(0.25) 2.4-2.9	2.6(0.35) 2.4-3.0	2.43(0.21) 2.2-2.6	2.56(0.26) 2.2-3.0
high	2.47(0.21) 2.3-2.7	2.57(0.06) 2.5-2.6	2.43(0.23) 2.3-2.7	2.49(0.17) 2.3-2.7
pooled	2.67(0.33) 1.8-3.5	2.66(0.33) 1.4-3.3	2.71(0.34) 1.9-3.7	2.68(0.33) 1.4-3.7

TREE-AVERAGE ANALYSIS FOR LATIFOLIA/STUMP

This section presents the results from analysis of variance with latewood and earlywood mixed together as in pulping. Results are presented for 11 variables and the necessary summary tables follow. If there were no significant differences, the pooled values are given here. All tests were done at the 5% level.

1. FIBER LENGTH

the latitude means were significantly different

2. MICROFIBRIL ANGLE

the latitude means were significantly different

3. LATEWOOD PERCENTAGE

the latitude and elevation means were significantly different (n=81 for each elevation)

low	med	high
ave = 12.11	ave = 12.42	ave = 13.3
std = 3.11	std = 3.28	std = 3.49
4.0-20.0	7.0-20.0	5.0-20.0

4. RESIN CANAL NUMBER

there were no significant differences -- pooled values are
ave = 38.52
std = 9.14 (range : 20.0 - 56.0)

5. RESIN CANAL DIAMETER

there were no significant differences -- pooled values are
ave = 72.71
std = 6.38 (range : 57.0 - 90.0)

6. TANGENTIAL CELL DIAMETER

there were no significant differences -- pooled values are
ave = 32.58
std = 4.07 (range : 15.2 - 49.0)

7. TANGENTIAL LUMEN DIAMETER

there were no significant differences -- pooled values are
ave = 27.76
std = 4.08 (range : 12.0 - 45.6)

8. RADIAL WALL THICKNESS

the LxE interaction was significant

9. RADIAL CELL DIAMETER

the LxD interaction was significant

10. RADIAL LUMEN DIAMETER

---

the LxD interaction was significant

11. TANG. WALL THICKNESS

---

the latitude means were significantly different

SUMMARIES BY LATITUDE -- LATIFOLIA/STUMP

LAT	FIBER LENGTH	MICROFIBRIL ANGLE
40	2.73(0.37) 2.0-3.3	33.13(3.5) 26.3-38.5
42.5	2.67(0.39) 1.99-3.3	33.43(4.07) 26.4-42.1
45	2.47(0.29) 2.1-3.1	30.08(3.57) 24.3-37.2
47.5	2.3(0.22) 2.0-3.0	33.08(3.27) 27.6-39.5
50	2.51(0.37) 1.6-3.1	28.65(3.76) 21.6-36.6
52.5	2.28(0.30) 1.8-3.0	29.44(3.9) 21.2-36.9
55	2.37(0.30) 1.9-3.1	28.7(3.95) 18.7-34.6
57.5	2.48(0.40) 1.7-3.4	29.67(2.74) 24.0-36.3
60	2.43(0.39) 1.7-3.3	28.07(3.82) 19.6-35.2

LAT	LATEWOOD PERCENTAGE	TANG. WALL THICKNESS
40	11.52(3.37) 8.0-20.0	1.70(0.43) 1.1-2.6
42.5	13.22(3.36) 8.0-20.0	1.88(0.39) 1.1-3.2
45	13.93(3.1) 8.0-19.0	1.9(0.33) 1.3-2.3
47.5	14.22(3.0) 9.0-19.0	2.07(0.51) 1.1-3.2
50	12.15(3.55) 5.0-20.0	1.81(0.36) 1.1-2.4
52.5	12.96(3.68) 8.0-19.0	1.69(0.29) 1.1-2.6
55	12.3(3.95) 4.0-19.0	1.7(0.29) 1.2-2.2
57.5	11.74(2.47) 7.0-19.0	1.88(0.46) 0.7-2.7
60	11.44(2.15) 9.0-18.0	1.48(0.27) 1.1-1.9

SUMMARIES BY LATITUDE AND ELEV -- LATIFOLIA/STUMP

RADIAL WALL THICKNESS

LAT	LOW	MEDIUM	HIGH
40	2.3(0.48) 1.6-3.2	2.33(0.62) 1.2-3.2	1.92(0.54) 1.3-3.0
42.5	2.29(0.54) 1.4-2.95	2.61(0.72) 1.7-4.1	2.45(0.56) 1.4-3.2
45	2.54(0.28) 2.1-2.8	2.58(0.27) 2.2-2.97	2.43(0.31) 1.9-2.9
47.5	2.74(0.37) 2.3-3.3	2.62(0.47) 1.8-3.3	2.77(0.46) 2.3-3.8
50	2.48(0.23) 2.2-2.9	2.14(0.42) 1.7-2.9	2.49(0.72) 1.7-4.1
52.5	2.28(0.47) 1.6-3.2	2.26(0.50) 1.6-2.9	2.28(0.25) 1.8-2.7
55	2.42(0.28) 1.8-2.7	2.39(0.34) 1.8-2.8	2.65(0.19) 2.4-2.9
57.5	2.27(0.36) 1.8-2.7	2.11(0.56) 1.0-3.2	2.78(0.67) 2.1-4.2
60	2.44(0.33) 2.2-3.2	2.41(0.36) 1.7-2.9	2.1(0.35) 1.8-2.7

SUMMARIES BY LATITUDE AND DIAM -- LATIFOLIA/STUMP

RADIAL CELL DIAMETER

LAT	76 mm dbh	152 mm dbh	228 mm dbh
40	32.99(3.05) 27.4-37.1	33.81(4.41) 28.2-42.8	34.05(2.73) 30.7-38.5
42.5	32.11(2.38) 28.0-34.5	32.88(3.97) 27.9-38.6	32.74(1.75) 29.5-34.1
45	31.54(2.23) 29.2-35.2	32.6(2.59) 28.4-37.4	33.61(3.31) 27.1-37.9
47.5	33.14(3.23) 28.3-37.96	33.43(2.3) 28.9-35.8	34.41(2.64) 30.8-40.0
50	34.86(6.19) 25.4-48.4	32.47(4.05) 25.6-37.8	35.34(5.42) 25.9-44.2
52.5	33.9(3.84) 29.9-41.2	31.74(7.54) 16.5-41.8	35.19(3.09) 31.4-42.0
55	34.62(4.15) 26.8-40.2	33.96(3.85) 26.8-38.8	35.39(3.72) 29.7-40.6
57.5	28.56(4.29) 21.1-35.4	38.22(6.57) 30.4-49.9	33.75(4.64) 26.3-39.9
60	30.42(2.16) 27.1-33.1	31.95(2.67) 28.6-35.0	33.39(3.07) 28.6-36.9

RADIAL LUMEN DIAMETER

LAT	76 mm dbh	152 mm dbh	228 mm dbh
40	29.67(3.15) 24.6-34.6	30.06(4.64) 24.8-39.4	30.88(2.94) 27.7-35.2
42.5	28.76(2.65) 23.9-31.1	28.83(3.75) 23.6-35.3	28.88(1.65) 26.1-30.9
45	27.61(2.24) 25.2-31.5	28.8(2.6) 24.8-33.1	29.95(3.49) 22.8-33.6
47.5	29.0(2.95) 24.8-33.3	29.58(2.25) 25.8-32.1	29.97(3.22) 26.0-37.5
50	31.17(6.4) 22.9-46.1	28.59(4.34) 20.8-34.5	32.09(5.62) 22.8-41.5
52.5	30.64(3.74) 26.6-37.9	28.37(7.31) 14.3-38.6	31.67(3.39) 26.9-38.4
55	31.31(4.42) 23.3-36.8	30.45(4.0) 23.1-35.7	31.98(3.52) 26.1-37.0
57.5	24.62(4.7) 15.7-31.2	34.41(6.21) 27.5-45.6	30.21(4.84) 20.9-36.6
60	27.54(2.37) 23.4-30.5	28.83(2.54) 26.0-31.8	30.49(3.44) 25.1-34.6

TREE-AVERAGE ANALYSIS FOR LATIFOLIA/TAP ROOT

This section presents the results from analysis of variance with latewood and earlywood mixed together as in pulping. Results are presented for 11 variables and the necessary summary tables follow. If there were no significant differences, the pooled values are given here. All tests were done at the 5% level.

1. FIBER LENGTH

   the latitude means were significantly different and the ExD interaction was significant

2. MICROFIBRIL ANGLE

   the latitude means were significantly different and the ExD interaction was significant

3. LATEWOOD PERCENTAGE

   the LxExD and ExD interactions were significant

4. RESIN CANAL NUMBER

   the latitude means were significantly different

5. RESIN CANAL DIAMETER

   the LxE interaction was significant

6. TANGENTIAL CELL DIAMETER

   the latitude means were significantly different

7. TANGENTIAL LUMEN DIAMETER

   the latitude means were significantly different

8. RADIAL WALL THICKNESS

   the LxE interaction was significant

9. RADIAL CELL DIAMETER

   the LxExD, ExD and LxE interactions were significant

10. RADIAL LUMEN DIAMETER

    the LxExD, ExD and LxE interactions were significant

11. TANG. WALL THICKNESS

    the LxExD, LxD and LxE interactions were significant

SUMMARIES BY LATITUDE AND ELEV -- LATIFOLIA/TAP ROOT

RESIN CANAL DIAMETER

LAT	LOW	MEDIUM	HIGH
40	71.44(7.02) 64-81	73.11(6.53) 63-80	70.56(9.34) 54-85
42.5	71.0(4.21) 66-80	70.67(8.47) 60-83	70.67(5.77) 59-79
45	71.33(5.83) 61-81	75.11(4.46) 66-81	73.67(6.23) 63-81
47.5	74.22(5.76) 64-81	76.22(6.94) 67-87	69.89(6.53) 60-80
50	72.22(5.17) 65-80	71.89(5.16) 67-81	77.56(4.64) 68-84
52.5	71.56(5.81) 60-80	71.89(6.37) 60-81	73.22(6.92) 62-81
55	73.78(6.63) 62-80	67.78(6.65) 60-77	70.67(8.28) 60-81
57.5	70.78(5.72) 61-77	76.56(4.83) 68-84	69.22(3.67) 64-74
60	75.33(6.33) 62-81	72.33(5.52) 63-82	67.78(4.35) 60-74

RADIAL WALL THICKNESS

LAT	LOW	MEDIUM	HIGH
40	2.18(0.38) 1.6-2.6	2.1(0.51) 1.7-3.1	1.62(0.26) 1.2-2.1
42.5	2.05(0.48) 1.2-2.7	2.2(0.42) 1.6-3.2	2.09(0.27) 1.6-2.4
45	2.14(0.39) 1.6-2.7	2.36(0.40) 1.7-3.2	2.22(0.20) 1.9-2.7
47.5	2.26(0.37) 1.7-2.7	2.06(0.59) 1.1-3.1	2.2(0.41) 1.7-3.1
50	2.16(0.20) 1.7-2.4	2.22(0.35) 1.7-2.7	2.22(0.27) 1.7-2.6
52.5	2.24(0.31) 1.8-2.7	1.91(0.25) 1.7-2.2	1.86(0.35) 1.6-2.7
55	1.89(0.22) 1.7-2.1	2.05(0.40) 1.6-2.7	2.03(0.24) 1.7-2.3
57.5	2.22(0.43) 1.7-3.1	1.88(0.38) 1.1-2.2	2.52(0.49) 1.6-3.2
60	2.01(0.34) 1.7-2.6	1.96(0.35) 1.7-2.6	1.91(0.24) 1.7-2.2

SUMMARIES BY LATITUDE -- LATIFOLIA/TAP ROOT

LAT	RESIN CANAL NUMBER	TANG. CELL DIAMETER
40	37.78(7.13) 24-56	32.01(3.92) 25.0-40.9
42.5	37.63(9.3) 20-52	30.68(3.75) 25.3-39.1
45	38.37(6.77) 28-48	32.15(3.01) 25.5-36.5
47.5	42.82(9.2) 24-56	33.0(3.19) 28.5-39.4
50	38.07(8.83) 24-56	33.08(4.0) 26.9-46.5
52.5	40.89(11.76) 20-60	32.02(6.12) 13.1-41.1
55	40.3(11.58) 20-56	34.57(3.86) 25.2-42.7
57.5	34.3(8.99) 20-52	30.44(3.79) 24.6-37.3
60	41.63(8.75) 28-56	31.05(2.69) 26.6-36.2

LAT	TANG.LUMEN DIAMETER
40	28.04(3.96) 20.8-35.6
42.5	26.45(3.76) 20.6-35.5
45	27.66(2.82) 22.3-32.0
47.5	28.65(3.17) 23.5-34.7
50	28.69(3.96) 22.6-41.1
52.5	28.02(6.35) 9.0-37.7
55	30.59(3.71) 21.8-38.7
57.5	26.02(3.7) 20.3-33.9
60	27.12(2.53) 23.2-31.8

SUMMARIES BY LAT, ELEV AND DIAM -- LATIFOLIA/TAP ROOT

FIBER LENGTH

ELEV	76 mm	152 mm	228 mm	All trees
		40 degrees lat		
low	2.49(0.18) 2.3-2.6	2.23(0.23) 2.1-2.5	2.52(0.16) 2.4-2.7	2.41(0.22) 2.1-2.7
med	2.33(0.17) 2.2-2.5	2.25(0.31) 2.1-2.6	2.4(0.31) 2.1-2.7	2.33(0.25) 2.1-2.7
high	2.17(0.37) 1.8-2.5	2.62(0.41) 2.2-2.9	2.28(0.31) 2.0-2.6	2.36(0.38) 1.8-2.9
		42.5 degrees lat		
low	2.12(0.11) 2.0-2.2	2.29(0.22) 2.1-2.5	2.67(0.72) 1.8-3.2	2.36(0.45) 1.8-3.2
med	2.39(0.55) 1.9-3.0	2.23(0.25) 2.0-2.5	2.3(0.35) 2.0-2.7	2.31(0.36) 1.9-3.0
high	2.27(0.53) 1.9-2.9	2.14(0.32) 1.9-2.5	2.01(0.33) 1.6-2.3	2.14(0.37) 1.6-2.9
		45 degrees lat		
low	2.16(0.55) 1.7-2.7	2.2(0.13) 2.1-2.3	2.04(0.07) 2.0-2.1	2.13(0.29) 1.7-2.7
med	1.84(0.27) 1.7-2.2	1.96(0.17) 1.8-2.1	2.06(0.36) 1.7-2.4	1.95(0.26) 1.7-2.4
high	2.53(0.27) 2.2-2.7	2.12(0.17) 2.0-2.3	2.05(0.27) 1.7-2.2	2.23(0.31) 1.7-2.7
		47.5 degrees lat		
low	1.65(0.17) 1.5-1.8	1.86(0.12) 1.8-2.0	1.83(0.29) 1.5-2.1	1.78(0.21) 1.5-2.1
med	1.61(0.14) 1.5-1.7	1.8(0.26) 1.6-2.1	1.96(0.34) 1.6-2.2	1.79(0.27) 1.5-2.2
high	1.93(0.24) 1.7-2.1	1.9(0.48) 1.4-2.4	1.7(0.23) 1.5-1.9	1.84(0.31) 1.4-2.4
		50 degrees lat		
low	2.12(0.08) 2.0-2.2	2.2(0.31) 1.9-2.5	2.37(0.09) 2.3-2.5	2.23(0.20) 1.9-2.5
med	2.14(0.41) 1.8-2.6	2.35(0.57) 2.0-3.0	1.93(0.33) 1.6-2.2	2.14(0.43) 1.6-3.0
high	2.25(0.47) 1.7-2.6	2.64(0.32) 2.3-2.9	2.17(0.46) 1.7-2.7	2.36(0.43) 1.7-2.9

ELEV	76 mm	152 mm	228 mm	All trees
		52.5 degrees lat		
low	2.42(0.29) 2.1-2.6	1.75(0.09) 1.7-1.8	1.94(0.15) 1.8-2.1	2.04(0.34) 1.7-2.6
med	2.0(0.26) 1.7-2.2	1.64(0.37) 1.4-2.1	2.14(0.37) 1.8-2.5	1.93(0.37) 1.4-2.5
high	2.27(0.25) 2.1-2.6	2.27(0.57) 1.9-2.9	2.15(0.41) 1.8-2.6	2.23(0.38) 1.8-2.9
		55 degrees lat		
low	2.26(0.52) 1.7-2.6	2.2(0.29) 1.9-2.5	1.89(0.11) 1.8-2.0	2.12(0.35) 1.7-2.6
med	2.34(0.27) 2.0-2.5	1.63(0.43) 1.2-2.0	2.27(0.37) 1.9-2.5	2.08(0.46) 1.2-2.5
high	2.49(0.34) 2.2-2.8	2.34(0.61) 1.9-3.0	1.88(0.19) 1.7-2.1	2.23(0.46) 1.7-3.0
		57.5 degrees lat		
low	2.38(0.19) 2.2-2.6	2.07(0.17) 1.9-2.2	2.57(0.22) 2.4-2.8	2.34(0.28) 1.9-2.8
med	2.21(0.21) 2.0-2.3	2.49(0.05) 2.5-2.6	2.34(0.71) 1.8-3.1	2.35(0.39) 1.8-3.1
high	2.13(0.14) 2.0-2.2	2.26(0.55) 1.7-2.8	2.07(0.52) 1.7-2.7	2.16(0.40) 1.7-2.8
		60 degrees lat		
low	2.6(0.35) 2.2-2.9	2.05(0.70) 1.4-2.8	2.03(0.27) 1.7-2.3	2.23(0.50) 1.4-2.9
med	2.01(0.16) 1.8-2.2	1.84(0.14) 1.7-1.9	1.87(0.21) 1.6-2.0	1.91(0.17) 1.6-2.2
high	1.86(0.06) 1.8-1.9	2.23(0.63) 1.5-2.8	2.04(0.28) 1.8-2.3	2.04(0.38) 1.5-2.8
pooled	2.18(0.36) 1.5-3.0	2.13(0.41) 1.2-3.0	2.13(0.37) 1.5-3.2	2.15(0.38) 1.2-3.2

SUMMARIES BY LAT, ELEV AND DIAM -- LATIFOLIA/TAP ROOT

MICROFIBRIL ANGLE

ELEV	76 mm	152 mm	228 mm	All trees
		40 degrees lat		
low	34.85(1.52) 33.2-36.1	31.44(2.33) 29.9-34.1	35.01(3.13) 32.9-38.6	33.77(2.72) 29.9-38.6
med	29.79(5.02) 24.0-32.9	35.82(4.57) 30.6-39.1	36.18(3.36) 32.3-38.2	33.93(4.9) 24.0-39.1
high	36.76(2.69) 33.9-39.2	32.52(3.18) 29.1-35.4	32.32(4.02) 27.8-35.6	33.87(3.62) 27.8-39.2
		42.5 degrees lat		
low	34.48(0.63) 34.0-35.2	28.79(0.78) 27.9-29.3	30.02(5.19) 25.6-35.8	31.1(3.7) 25.6-35.8
med	31.18(4.09) 27.8-35.7	36.94(2.12) 34.5-38.3	32.37(3.51) 29.6-36.3	33.49(3.92) 27.8-38.3
high	35.24(2.42) 32.7-37.5	35.47(0.78) 34.7-36.3	35.76(3.48) 33.0-39.7	35.49(2.17) 32.7-39.7
		45 degrees lat		
low	35.61(4.12) 33.0-40.4	27.73(3.61) 24.0-31.2	31.48(2.33) 28.8-33.0	31.61(4.53) 24.0-40.4
med	33.67(6.27) 26.8-39.1	33.69(3.97) 30.6-38.2	33.4(5.29) 28.5-39.0	33.58(4.56) 26.8-39.1
high	28.95(4.37) 24.3-33.0	30.87(4.67) 26.9-36.0	32.85(6.12) 28.9-39.9	30.89(4.74) 24.3-39.9
		47.5 degrees lat		
low	37.27(1.76) 35.6-39.1	34.9(5.4) 28.7-38.1	35.02(0.87) 34.4-36.0	35.73(3.1) 28.7-39.1
med	34.46(2.17) 32.0-35.9	38.03(4.31) 33.3-41.7	37.51(3.93) 35.1-42.0	36.67(3.53) 32.0-42.0
high	38.28(1.14) 37.6-39.6	33.9(2.67) 30.9-36.0	38.26(4.04) 35.4-42.9	36.82(3.31) 30.9-42.9
		50 degrees lat		
low	30.69(3.13) 28.1-34.2	28.29(5.02) 24.6-34.0	26.71(6.08) 22.6-33.7	28.56(4.58) 22.6-34.2
med	29.44(5.47) 23.7-34.6	30.76(5.27) 26.6-36.7	33.14(4.38) 30.5-38.2	31.11(4.67) 23.7-38.2
high	32.92(4.81) 27.8-37.4	30.43(2.47) 28.9-33.3	32.26(5.51) 27.5-38.3	31.87(4.02) 27.5-38.3

ELEV	76 mm	152 mm	228 mm	All trees
		52.5 degrees lat		
low	29.45(6.18) 22.5-34.3	38.18(0.98) 37.1-39.0	30.76(3.39) 27.9-34.5	32.8(5.41) 22.5-39.0
med	27.96(5.8) 24.3-34.7	32.57(4.03) 29.8-37.2	31.07(5.39) 26.7-37.1	30.53(4.89) 24.3-37.2
high	29.37(1.05) 28.2-30.3	28.03(2.99) 24.6-29.8	31.08(4.39) 26.2-34.7	29.49(3.01) 24.6-34.7
		55 degrees lat		
low	34.69(5.47) 28.4-38.3	30.53(7.49) 23.7-38.6	36.55(2.93) 33.4-39.1	33.92(5.55) 23.7-39.1
med	30.67(5.37) 25.9-36.5	33.87(3.76) 29.6-36.7	30.63(5.25) 27.3-36.7	31.72(4.5) 25.9-36.7
high	29.45(0.51) 29.0-30.0	27.22(4.22) 22.7-31.1	32.08(2.23) 29.7-34.1	29.59(3.19) 22.7-34.1
		57.5 degrees lat		
low	32.52(5.02) 26.7-35.4	28.61(0.62) 27.9-29.0	28.45(5.43) 23.6-34.3	29.86(4.21) 23.6-35.4
med	33.33(3.76) 29.0-35.7	30.75(3.75) 27.6-34.9	29.72(3.98) 25.8-33.8	31.26(3.69) 25.8-35.7
high	33.55(1.74) 31.7-35.2	33.06(4.22) 28.2-35.7	31.13(2.21) 29.7-33.7	32.58(2.77) 28.2-35.7
		60 degrees lat		
low	28.21(2.18) 25.7-29.8	30.45(9.48) 19.7-37.6	30.89(1.75) 29.1-32.6	29.85(5.1) 19.7-37.6
med	31.68(2.24) 29.9-34.2	32.97(4.48) 27.9-36.4	32.56(4.59) 29.2-37.8	32.4(3.45) 27.9-37.8
high	34.05(3.8) 29.8-37.0	31.09(4.99) 26.6-36.5	29.45(6.16) 23.8-36.0	31.53(4.84) 23.8-37.0
pooled	32.54(4.29) 22.5-40.4	32.11(4.65) 19.7-41.7	32.47(4.46) 22.6-42.9	32.37(4.45) 19.7-42.9

SUMMARIES BY LAT, ELEV AND DIAM -- LATIFOLIA/TAP ROOT

LATEWOOD PERCENTAGE

ELEV	76 mm	152 mm	228 mm	All trees
		40 degrees lat		
low	9.0(1.73) 7-10	9.0(1.0) 8-10	10.0(4.0) 6-14	9.33(2.29) 6-14
med	12.33(4.04) 8-16	8.33(2.08) 6-10	11.0(2.65) 9-14	10.56(3.17) 6-16
high	12.33(3.79) 8-15	9.67(2.89) 8-13	7.33(1.16) 6- 8	9.78(3.27) 6-15
		42.5 degrees lat		
low	11.67(2.08) 10-14	9.67(0.58) 9-10	10.33(2.08) 8-12	10.56(1.74) 8-14
med	11.0(2.65) 9-14	16.33(3.22) 14-20	9.67(1.53) 8-11	12.33(3.78) 8-20
high	14.67(1.53) 13-16	10.67(3.06) 8-14	10.0(1.0) 9-11	11.78(2.82) 8-16
		45 degrees lat		
low	9.33(1.53) 8-11	9.67(0.58) 9-10	11.33(1.16) 10-12	10.11(1.36) 8-12
med	12.67(2.08) 11-15	12.33(3.06) 9-15	10.67(0.58) 10-11	11.89(2.09) 9-15
high	13.0(5.2) 10-19	10.67(0.58) 10-11	11.0(1.0) 10-12	11.56(2.88) 10-19
		47.5 degrees lat		
low	8.67(1.16) 8-10	11.67(0.58) 11-12	10.67(1.53) 9-12	10.33(1.66) 8-12
med	11.67(1.53) 10-13	8.0(1.73) 6- 9	11.67(1.53) 10-13	10.44(2.3) 6-13
high	11.67(4.04) 8-16	10.33(0.58) 10-11	8.33(0.58) 8- 9	10.11(2.52) 8-16
		50 degrees lat		
low	10.67(1.16) 10-12	9.67(0.58) 9-10	12.67(2.31) 10-14	11.0(1.87) 9-14
med	11.33(3.22) 9-15	11.0(1.0) 10-12	8.67(0.58) 8- 9	10.33(2.12) 8-15
high	9.33(3.79) 5-12	12.33(4.93) 9-18	7.67(1.53) 6- 9	9.78(3.8) 5-18

ELEV	76 mm	152 mm	228 mm	All trees
		52.5 degrees lat		
low	10.33(0.58) 10-11	9.67(1.53) 8-11	10.33(1.53) 9-12	10.11(1.17) 8-12
med	9.0(1.0) 8-10	8.67(1.16) 8-10	9.0(0.0) 9- 9	8.89(0.78) 8-10
high	6.67(0.58) 6- 7	11.33(2.52) 9-14	9.33(0.58) 9-10	9.11(2.42) 6-14
		55 degrees lat		
low	8.33(1.53) 7-10	11.67(3.22) 8-14	10.0(1.0) 9-11	10.0(2.35) 7-14
med	7.67(2.52) 5-10	10.67(0.58) 10-11	9.33(1.53) 8-11	9.22(1.99) 5-11
high	10.67(3.79) 8-15	9.0(1.0) 8-10	8.67(0.58) 8- 9	9.44(2.19) 8-15
		57.5 degrees lat		
low	10.67(2.08) 9-13	9.0(1.0) 8-10	9.33(0.58) 9-10	9.67(1.41) 8-13
med	9.67(0.58) 9-10	11.0(1.73) 10-13	8.33(1.53) 7-10	9.67(1.66) 7-13
high	11.33(2.89) 8-13	9.0(1.0) 8-10	10.67(3.51) 7-14	10.33(2.55) 7-14
		60 degrees lat		
low	9.33(0.58) 9-10	9.33(1.53) 8-11	10.33(2.52) 8-13	9.67(1.58) 8-13
med	9.33(0.58) 9-10	9.33(1.16) 8-10	9.67(1.53) 8-11	9.44(1.01) 8-11
high	10.0(1.73) 9-12	9.67(0.58) 9-10	8.67(0.58) 8- 9	9.44(1.13) 8-12
pooled	10.46(2.7) 5-19	10.28(2.31) 6-20	9.8(1.86) 6-14	10.18(2.33) 5-20

SUMMARIES BY LAT, ELEV AND DIAM -- LATIFOLIA/TAP ROOT

RADIAL CELL DIAMETER

ELEV	76 mm	152 mm	228 mm	All trees
		40 degrees lat		
low	37.79(4.15) 33.7-42.0	39.62(5.13) 35.9-45.5	33.06(1.67) 32.0-35.0	36.82(4.49) 32.0-45.5
med	31.06(6.74) 23.9-37.3	31.26(2.54) 28.5-33.4	33.33(3.08) 29.9-35.9	31.89(4.06) 23.9-37.3
high	33.21(3.15) 30.3-36.6	31.36(1.15) 30.1-32.4	33.55(4.05) 28.9-36.0	32.71(2.82) 28.9-36.6
		42.5 degrees lat		
low	31.23(1.31) 30.2-32.7	34.03(6.66) 28.4-41.4	31.96(2.32) 29.7-34.4	32.41(3.8) 28.4-41.4
med	28.69(2.93) 25.7-31.6	38.31(3.45) 34.4-40.9	33.02(1.82) 31.1-34.7	33.34(4.83) 25.7-40.9
high	31.3(3.29) 28.1-34.7	28.83(2.99) 25.9-31.9	30.78(2.47) 28.5-33.4	30.3(2.78) 25.9-34.7
		45 degrees lat		
low	27.25(2.32) 25.8-29.9	33.95(2.08) 31.6-35.6	29.88(3.48) 26.4-33.4	30.36(3.74) 25.8-35.6
med	32.77(2.9) 30.0-35.8	32.49(1.69) 30.6-33.7	33.54(1.51) 31.8-34.5	32.93(1.9) 30.0-35.8
high	33.02(2.97) 29.8-35.6	34.8(0.40) 34.5-35.2	36.8(0.50) 36.2-37.2	34.87(2.23) 29.8-37.2
		47.5 degrees lat		
low	35.33(5.57) 29.0-39.3	34.93(1.33) 33.6-36.2	30.99(3.76) 28.4-35.3	33.75(4.01) 28.4-39.3
med	31.79(1.92) 29.6-33.2	31.75(2.88) 28.7-34.5	34.0(1.09) 32.8-34.9	32.52(2.13) 28.7-34.9
high	34.14(3.58) 30.8-37.9	32.65(1.86) 31.5-34.8	35.26(3.14) 31.9-38.1	34.02(2.8) 30.8-38.1
		50 degrees lat		
low	33.95(4.38) 29.3-38.0	34.56(3.74) 30.9-38.4	36.91(3.3) 33.3-39.8	35.14(3.59) 29.3-39.8
med	32.44(2.3) 30.0-34.6	31.79(1.37) 30.2-32.8	47.0(10.83) 36.1-57.8	37.08(9.31) 30.0-57.8
high	33.74(7.31) 27.2-41.6	30.08(4.78) 24.8-34.2	32.31(2.63) 29.3-33.9	32.04(4.83) 24.8-41.6

ELEV	76 mm	152 mm	228 mm	All trees
		52.5 degrees lat		
low	31.94(2.11) 30.2-34.3	25.95(11.77) 12.8-35.4	33.29(4.48) 28.3-37.0	30.39(7.23) 12.8-37.0
med	33.19(4.77) 29.3-38.5	35.82(8.31) 27.1-43.6	35.62(3.7) 32.9-39.8	34.88(5.29) 27.1-43.6
high	37.02(3.55) 33.1-40.0	36.29(4.25) 33.2-41.1	30.27(6.46) 23.2-35.8	34.53(5.33) 23.2-41.1
		55 degrees lat		
low	34.12(4.66) 29.1-38.3	33.08(5.83) 26.4-36.8	35.84(3.57) 32.6-39.7	34.34(4.31) 26.4-39.7
med	31.41(3.85) 27.1-34.5	37.2(3.51) 35.0-41.2	39.21(4.69) 35.4-44.4	35.94(4.96) 27.1-44.4
high	36.83(3.48) 33.9-40.7	34.1(2.81) 31.0-36.5	34.89(1.64) 33.1-36.3	35.27(2.67) 31.0-40.7
		57.5 degrees lat		
low	35.22(1.62) 33.6-36.8	30.18(2.21) 27.6-31.7	29.49(3.42) 25.9-32.7	31.63(3.49) 25.9-36.8
med	27.54(0.54) 26.9-27.9	32.23(4.92) 27.6-37.4	33.39(4.42) 28.7-37.5	31.05(4.27) 26.9-37.5
high	26.02(6.84) 21.0-33.8	33.51(5.56) 27.9-39.0	33.53(2.81) 31.7-36.8	31.02(5.95) 21.0-39.0
		60 degrees lat		
low	31.39(0.69) 30.7-32.0	34.85(1.25) 33.5-35.9	32.6(1.59) 31.7-34.4	32.95(1.86) 30.7-35.9
med	30.2(1.02) 29.3-31.3	30.93(1.0) 29.8-31.7	32.27(0.81) 31.7-33.2	31.14(1.23) 29.3-33.2
high	29.16(0.80) 28.7-30.1	34.62(1.09) 33.4-35.5	31.75(2.76) 29.0-34.5	31.84(2.82) 28.7-35.5
pooled	32.29(4.24) 21.0-42.0	33.3(4.57) 12.8-45.5	33.87(4.61) 23.2-57.8	33.15(4.51) 12.8-57.8

SUMMARIES BY LAT, ELEV AND DIAM -- LATIFOLIA/TAP ROOT

RADIAL LUMEN DIAMETER

ELEV	76 mm	152 mm	228 mm	All trees
		40 degrees lat		
low	34.31(4.25) 30.5-38.9	35.96(4.62) 33.1-41.3	30.47(2.11) 28.7-32.8	33.58(4.11) 28.7-41.3
med	28.1(6.89) 21.3-35.1	28.28(2.03) 26.1-30.1	31.02(3.03) 27.7-33.7	29.13(4.14) 21.3-35.1
high	30.01(3.22) 27.0-33.4	28.75(1.57) 27.0-29.9	31.11(3.82) 26.7-33.6	29.96(2.81) 26.7-33.6
		42.5 degrees lat		
low	28.65(1.62) 27.1-30.3	30.44(6.81) 25.1-38.1	28.08(2.37) 25.5-30.1	29.06(3.85) 25.1-38.1
med	25.48(3.02) 22.5-28.5	35.22(3.66) 31.0-37.5	29.16(2.16) 27.7-31.6	29.95(4.99) 22.5-37.5
high	26.96(3.38) 23.6-30.4	25.81(2.56) 22.5-29.6	27.85(2.95) 25.4-31.1	26.87(3.0) 22.5-31.1
		45 degrees lat		
low	24.3(1.11) 23.5-25.6	29.73(1.55) 28.3-31.4	26.91(3.55) 23.1-30.1	26.98(3.1) 23.1-31.4
med	29.69(2.49) 27.6-32.4	28.12(0.82) 27.2-28.7	30.11(1.39) 28.5-30.9	29.3(1.74) 27.2-32.4
high	29.97(2.58) 27.2-32.3	30.89(0.59) 30.2-31.4	34.06(1.01) 32.9-34.8	31.64(2.34) 27.2-34.8
		47.5 degrees lat		
low	31.73(6.13) 24.7-36.1	31.72(1.46) 30.0-32.6	27.1(3.84) 23.5-31.1	30.18(4.36) 23.5-36.1
med	28.1(2.47) 25.4-30.2	29.8(3.02) 26.4-32.1	31.24(0.85) 30.3-31.8	29.71(2.42) 25.4-32.1
high	31.4(3.05) 28.4-34.4	29.01(2.19) 27.4-31.5	31.99(3.61) 28.6-35.8	30.8(2.94) 27.4-35.8
		50 degrees lat		
low	30.3(4.35) 26.0-34.7	31.34(3.38) 28.6-35.1	33.28(3.86) 29.0-36.6	31.64(3.61) 26.0-36.6
med	29.4(2.47) 26.6-31.3	28.17(1.11) 26.9-29.0	44.38(11.32) 33.0-55.6	33.98(9.74) 26.6-55.6
high	31.11(7.5) 24.8-39.4	26.08(5.29) 20.1-30.2	28.27(2.59) 25.3-29.8	28.49(5.25) 20.1-39.4

ELEV	76 mm	152 mm	228 mm	All trees
		52.5 degrees lat		
low	29.01(2.89) 26.1-31.9	23.59(11.68) 10.5-33.0	29.42(4.9) 24.1-33.7	27.34(7.08) 10.5-33.7
med	30.56(5.18) 26.0-36.2	33.17(8.82) 23.8-41.3	33.38(3.75) 30.7-37.7	32.37(5.62) 23.8-41.3
high	34.53(4.07) 30.0-37.8	33.97(4.37) 30.6-38.9	27.29(7.46) 19.0-33.5	31.93(5.91) 19.0-38.9
		55 degrees lat		
low	30.91(4.18) 26.7-35.1	30.34(5.58) 24.0-34.3	32.63(3.54) 29.5-36.5	31.29(4.04) 24.0-36.5
med	28.47(3.2) 24.9-31.1	34.06(3.91) 31.7-38.6	36.31(5.16) 32.3-42.1	32.95(5.03) 24.9-42.1
high	34.12(3.57) 31.6-38.2	31.34(2.77) 28.5-34.0	32.21(1.63) 30.7-33.9	32.56(2.7) 28.5-38.2
		57.5 degrees lat		
low	31.96(1.52) 30.5-33.5	27.22(2.48) 24.4-28.9	26.24(2.52) 23.6-28.6	28.47(3.28) 23.6-33.5
med	25.25(0.52) 24.7-25.6	29.64(4.87) 25.5-35.0	30.8(4.44) 26.3-35.2	28.56(4.17) 24.7-35.2
high	21.08(7.39) 15.6-29.5	29.52(4.72) 24.4-33.7	29.9(3.64) 26.4-33.6	26.83(6.42) 15.6-33.7
		60 degrees lat		
low	29.02(0.69) 28.3-29.7	31.64(2.08) 29.4-33.5	29.95(1.88) 28.4-32.0	30.2(1.85) 28.3-33.5
med	26.92(1.1) 25.9-28.1	27.95(1.42) 26.6-29.4	29.45(0.78) 28.6-30.0	28.11(1.47) 25.9-30.0
high	26.89(0.73) 26.4-27.7	31.97(1.55) 30.2-33.1	28.49(2.74) 25.7-31.2	29.12(2.77) 25.7-33.1
pooled	29.19(4.39) 15.6-39.4	30.14(4.57) 10.5-41.3	30.78(4.86) 19.0-55.6	30.04(4.64) 10.5-55.6

SUMMARIES BY LAT, ELEV AND DIAM -- LATIFOLIA/TAP ROOT

TANG. WALL THICKNESS

ELEV	76 mm	152 mm	228 mm	All trees
		40 degrees lat		
low	1.74(0.29) 1.6-2.1	1.83(0.55) 1.2-2.2	1.29(0.31) 1.1-1.7	1.62(0.43) 1.1-2.2
med	1.48(0.46) 1.1-2.0	1.49(0.27) 1.2-1.7	1.16(0.11) 1.1-1.3	1.38(0.32) 1.1-2.0
high	1.6(0.04) 1.6-1.7	1.31(0.25) 1.1-1.6	1.22(0.24) 1.1-1.5	1.38(0.25) 1.1-1.7
		42.5 degrees lat		
low	1.29(0.24) 1.1-1.6	1.79(0.27) 1.6-2.1	1.94(0.31) 1.6-2.1	1.67(0.38) 1.1-2.1
med	1.61(0.05) 1.55-1.64	1.55(0.27) 1.2-1.7	1.93(0.55) 1.5-2.6	1.7(0.36) 1.2-2.6
high	2.17(0.06) 2.1-2.2	1.51(0.30) 1.2-1.7	1.47(0.29) 1.1-1.7	1.72(0.40) 1.1-2.2
		45 degrees lat		
low	1.47(0.61) 1.1-2.2	2.11(0.48) 1.7-2.6	1.48(0.32) 1.1-1.7	1.69(0.53) 1.1-2.6
med	1.54(0.28) 1.2-1.7	2.18(0.47) 1.7-2.6	1.71(0.06) 1.7-1.8	1.81(0.40) 1.2-2.6
high	1.53(0.21) 1.3-1.7	1.96(0.27) 1.7-2.1	1.37(0.26) 1.2-1.7	1.62(0.34) 1.2-2.1
		47.5 degrees lat		
low	1.8(0.28) 1.6-2.1	1.6(0.32) 1.2-1.8	1.95(0.59) 1.3-2.5	1.78(0.39) 1.2-2.5
med	1.85(0.58) 1.2-2.3	0.97(0.36) 0.6-1.2	1.38(0.23) 1.2-1.7	1.4(0.52) 0.6-2.3
high	1.37(0.32) 1.2-1.7	1.82(0.29) 1.7-2.2	1.64(0.47) 1.2-2.1	1.61(0.37) 1.2-2.2
		50 degrees lat		
low	1.83(0.31) 1.7-2.2	1.61(0.45) 1.2-2.1	1.82(0.29) 1.6-2.1	1.75(0.33) 1.2-2.2
med	1.52(0.25) 1.2-1.7	1.81(0.27) 1.7-2.1	1.31(0.25) 1.1-1.6	1.55(0.31) 1.1-2.1
high	1.31(0.25) 1.1-1.6	2.0(0.37) 1.6-2.4	2.02(0.04) 2.0-2.1	1.78(0.41) 1.1-2.4

ELEV	76 mm	152 mm	228 mm	All trees
		52.5 degrees lat		
low	1.47(0.51) 1.2-2.1	1.18(0.05) 1.1-1.2	1.94(0.25) 1.7-2.1	1.53(0.44) 1.1-2.1
med	1.31(0.27) 1.2-1.6	1.32(0.28) 1.2-1.7	1.12(0.03) 1.09-1.14	1.25(0.22) 1.1-1.7
high	1.24(0.28) 1.1-1.6	1.16(0.10) 1.1-1.3	1.49(0.52) 1.2-2.1	1.3(0.33) 1.1-2.1
		55 degrees lat		
low	1.61(0.43) 1.2-2.0	1.37(0.24) 1.2-1.6	1.6(0.06) 1.6-1.7	1.52(0.27) 1.2-2.0
med	1.47(0.33) 1.1-1.7	1.57(0.21) 1.3-1.7	1.45(0.25) 1.2-1.6	1.5(0.24) 1.1-1.7
high	1.36(0.32) 1.1-1.7	1.38(0.21) 1.3-1.6	1.34(0.25) 1.2-1.6	1.36(0.23) 1.1-1.7
		57.5 degrees lat		
low	1.63(0.08) 1.6-1.7	1.48(0.28) 1.2-1.7	1.62(0.46) 1.2-2.1	1.58(0.28) 1.2-2.1
med	1.15(0.01) 1.14-1.15	1.3(0.31) 1.1-1.7	1.3(0.21) 1.2-1.5	1.25(0.20) 1.1-1.7
high	2.47(0.28) 2.2-2.7	1.99(0.57) 1.6-2.7	1.82(0.76) 1.2-2.7	2.09(0.58) 1.2-2.7
		60 degrees lat		
low	1.19(0.01) 1.18-1.20	1.6(0.42) 1.2-2.1	1.33(0.28) 1.1-1.7	1.37(0.31) 1.1-2.1
med	1.64(0.04) 1.6-1.7	1.49(0.30) 1.2-1.7	1.41(0.31) 1.1-1.6	1.51(0.24) 1.1-1.7
high	1.14(0.05) 1.1-1.2	1.33(0.24) 1.2-1.6	1.63(0.01) 1.62-1.63	1.36(0.25) 1.1-1.6
pooled	1.55(0.39) 1.1-2.7	1.58(0.41) 0.6-2.7	1.55(0.38) 1.1-2.7	1.56(0.39) 0.6-2.7

TREE-AVERAGE ANALYSIS FOR LATIFOLIA/LATERAL ROOT

This section presents the results from analysis of variance with latewood and earlywood mixed together as in pulping. Results are presented for 11 variables and the necessary summary tables follow. If there were no significant differences, the pooled values are given here. All tests were done at the 5% level.

1. FIBER LENGTH

   the latitude means were significantly different
   note : the LxE interaction had a p-value of 0.052

2. MICROFIBRIL ANGLE

   the latitude means were significantly different

3. LATEWOOD PERCENTAGE

   the LxE interaction was significant

4. RESIN CANAL NUMBER

   the LxE interaction was significant

5. RESIN CANAL DIAMETER

   there were no significant differences -- pooled values are
   ave = 70.67
   std = 6.45 (range : 50.0 - 88.0)

6. TANGENTIAL CELL DIAMETER

   the latitude means were significantly different

7. TANGENTIAL LUMEN DIAMETER

   the LxE interaction was significant

8. RADIAL WALL THICKNESS

   the latitude means were significantly different

9. RADIAL CELL DIAMETER

   the LxExD, ExD and LxE interactions were significant

10. RADIAL LUMEN DIAMETER

    the LxExD, ExD and LxE interactions were significant

11. TANG. WALL THICKNESS

    the latitude means were significantly different

SUMMARIES BY LATITUDE AND ELEV -- LATIFOLIA/LATERAL ROOT

FIBER LENGTH

LAT	LOW	MEDIUM	HIGH	ALL
40	1.98(0.3) 1.6-2.5	2.07(0.25) 1.7-2.5	2.19(0.3) 1.8-2.6	2.08(0.29) 1.6-2.6
42.5	2.05(0.32) 1.5-2.5	2.06(0.26) 1.7-2.5	2.01(0.29) 1.5-2.4	2.04(0.28) 1.5-2.5
45	1.84(0.27) 1.4-2.3	1.78(0.24) 1.5-2.1	1.88(0.23) 1.7-2.2	1.83(0.24) 1.4-2.3
47.5	1.57(0.3) 1.2-1.98	1.86(0.24) 1.3-2.1	1.59(0.16) 1.3-1.8	1.67(0.27) 1.2-2.1
50	2.03(0.43) 1.3-2.6	1.88(0.36) 1.2-2.5	2.06(0.38) 1.6-2.7	1.99(0.38) 1.2-2.7
52.5	1.91(0.31) 1.5-2.4	1.82(0.32) 1.4-2.4	2.32(0.27) 1.98-2.8	2.02(0.37) 1.4-2.8
55	1.83(0.2) 1.6-2.1	2.07(0.39) 1.3-2.7	2.09(0.19) 1.9-2.5	1.99(0.29) 1.3-2.7
57.5	2.17(0.51) 1.3-2.95	2.16(0.42) 1.6-2.9	2.08(0.33) 1.7-2.7	2.14(0.41) 1.3-2.95
60	2.01(0.41) 1.5-2.8	1.8(0.36) 1.4-2.4	1.71(0.38) 1.3-2.5	1.84(0.39) 1.3-2.8

LATEWOOD PERCENTAGE

LAT	LOW	MEDIUM	HIGH
40	8.11(1.76) 5-10	12.22(3.49) 8-18	10.11(4.51) 6-20
42.5	10.67(2.69) 8-17	11.22(3.15) 6-16	10.0(2.45) 7-14
45	9.33(1.0) 8-11	10.44(1.59) 8-13	10.11(1.17) 9-12
47.5	10.56(2.96) 8-18	10.22(2.28) 6-13	10.11(2.76) 6-16
50	10.22(1.3) 8-12	9.22(1.56) 8-13	9.11(2.85) 5-14
52.5	10.67(1.87) 8-14	8.44(0.53) 8- 9	8.22(2.49) 5-13
55	9.56(2.7) 5-13	8.67(0.5) 8- 9	9.0(1.66) 8-13
57.5	9.22(0.83) 8-10	8.89(1.05) 7-10	8.89(1.76) 6-12
60	9.89(1.76) 7-12	8.78(1.2) 7-10	9.0(1.73) 7-12

RESIN CANAL NUMBER

LAT	LOW	MEDIUM	HIGH
40	32.44(5.81) 20-40	37.33(6.0) 32-52	39.11(7.94) 32-52
42.5	35.11(7.42) 28-48	36.0(8.25) 24-44	37.33(10.2) 28-56
45	36.44(5.81) 28-48	37.33(7.48) 28-52	34.67(6.93) 24-44
47.5	34.67(8.25) 20-48	40.89(9.33) 24-56	45.33(8.94) 32-56
50	40.0(4.9) 32-48	40.22(5.7) 32-52	36.0(7.75) 24-52
52.5	37.33(8.0) 24-48	38.22(12.35) 20-56	39.56(11.04) 24-52
55	42.67(11.66) 20-56	29.78(2.91) 28-36	43.56(13.48) 20-56
57.5	33.78(6.36) 28-48	41.33(10.0) 24-56	33.33(11.49) 20-52
60	40.44(8.82) 32-56	38.67(9.17) 24-52	40.44(5.81) 32-48

TANGENTIAL LUMEN DIAMETER

LAT	LOW	MEDIUM	HIGH
40	28.99(5.9) 22.4-38.5	25.86(3.22) 20.3-29.9	27.11(3.23) 23.6-32.3
42.5	24.94(3.34) 21.3-32.1	26.75(4.85) 19.2-33.4	24.26(3.4) 20.5-29.7
45	27.24(3.86) 22.2-34.1	29.13(2.69) 25.1-33.4	28.21(2.34) 25.2-31.6
47.5	27.35(3.24) 22.9-31.6	26.5(2.8) 21.6-30.4	28.62(2.43) 26.0-34.0
50	26.29(3.43) 20.2-31.7	27.96(5.52) 21.3-39.3	27.24(5.95) 19.1-41.0
52.5	24.14(6.81) 10.9-34.2	31.65(3.96) 24.5-36.1	30.46(3.83) 25.7-36.3
55	30.03(4.76) 21.8-37.1	29.64(4.69) 17.8-33.7	31.12(2.71) 26.6-35.5
57.5	28.66(3.95) 20.3-34.3	27.83(3.37) 23.2-33.4	27.33(4.12) 22.0-32.5
60	26.68(1.53) 24.9-29.0	28.61(2.92) 23.3-32.0	27.48(3.09) 23.1-31.6

SUMMARIES BY LATITUDE -- LATIFOLIA/LATERAL ROOT

LAT	MICROFIBRIL ANGLE	TANG. CELL DIAMETER
40	35.58(3.03) 29.3-41.8	31.01(4.51) 24.0-42.9
42.5	35.96(3.91) 25.9-44.6	29.29(3.88) 23.5-38.0
45	34.87(4.55) 28.5-44.5	32.37(3.17) 26.4-37.8
47.5	37.59(3.5) 30.1-43.6	31.72(3.06) 23.8-38.7
50	31.79(4.38) 24.3-39.7	31.45(4.57) 25.4-44.4
52.5	32.19(5.23) 20.4-40.2	32.55(5.74) 14.0-39.6
55	32.5(3.93) 24.0-38.4	34.23(4.25) 21.1-41.3
57.5	32.94(3.78) 24.9-39.0	32.09(3.26) 23.6-37.6
60	33.37(4.88) 23.3-40.7	31.37(2.6) 27.4-35.4

LAT	RADIAL WALL THICKNESS	TANG. WALL THICKNESS
40	1.85(0.43) 1.1-3.1	1.44(0.40) 1.1-2.6
42.5	1.99(0.35) 1.2-2.7	1.47(0.29) 1.1-2.1
45	2.09(0.35) 1.7-3.1	1.52(0.29) 1.1-2.1
47.5	2.12(0.40) 1.1-3.1	1.56(0.37) 1.0-2.6
50	2.14(0.34) 1.6-3.3	1.62(0.33) 1.0-2.7
52.5	1.9(0.32) 1.2-2.6	1.37(0.31) 1.0-2.1
55	1.98(0.29) 1.6-2.6	1.34(0.24) 1.1-1.8
57.5	2.07(0.56) 1.2-3.6	1.58(0.44) 1.0-3.1
60	1.89(0.27) 1.6-2.6	1.29(0.22) 1.1-1.6

SUMMARIES BY LAT, ELEV AND DIAM -- LATIFOLIA/LATERAL ROOT

RADIAL CELL DIAMETER

ELEV	76 mm	152 mm	228 mm	All trees
		40 degrees lat		
low	38.59(2.89) 35.7-41.5	37.19(6.72) 31.8-44.7	30.55(3.66) 28.0-34.7	35.45(5.53) 28.0-44.7
med	27.78(4.23) 23.6-32.1	32.18(2.83) 29.1-34.7	31.24(2.84) 28.7-34.3	30.4(3.54) 23.6-34.7
high	31.41(2.03) 29.6-33.6	30.66(2.31) 29.0-33.3	33.25(3.61) 29.1-35.7	31.77(2.64) 29.0-35.7
		42.5 degrees lat		
low	30.53(2.49) 28.7-33.4	32.78(5.89) 28.4-39.5	29.78(0.09) 29.7-29.9	31.03(3.47) 28.4-39.5
med	27.24(1.35) 25.7-28.2	38.11(1.75) 36.9-40.1	32.76(1.07) 31.6-33.7	32.7(4.86) 25.7-40.1
high	32.5(1.84) 31.3-34.6	28.38(4.04) 25.3-32.95	28.65(0.99) 27.6-29.5	29.84(3.02) 25.3-34.6
		45 degrees lat		
low	26.64(3.29) 23.3-29.9	33.91(2.98) 30.7-36.6	30.98(5.25) 25.8-36.3	30.51(4.67) 23.3-36.6
med	34.84(3.84) 30.5-37.9	32.74(1.07) 31.8-33.9	33.55(0.77) 32.7-34.2	33.71(2.23) 30.5-37.9
high	32.77(3.25) 29.9-36.3	33.38(2.15) 31.7-35.8	34.0(2.48) 31.4-36.4	33.4(2.37) 29.9-36.4
		47.5 degrees lat		
low	34.45(2.84) 31.7-37.4	34.89(3.82) 30.6-37.8	30.09(3.28) 26.7-33.2	33.14(3.69) 26.7-37.8
med	31.31(0.96) 30.4-32.3	31.08(1.74) 29.6-32.98	33.4(1.93) 31.2-34.8	31.93(1.77) 29.6-34.8
high	34.19(4.74) 30.8-39.6	31.05(0.75) 30.6-31.9	35.2(2.61) 32.7-37.9	33.48(3.31) 30.6-39.6
		50 degrees lat		
low	33.09(5.22) 29.5-39.1	32.07(3.17) 28.5-34.4	35.6(2.39) 33.5-38.2	33.59(3.64) 28.5-39.1
med	33.24(1.44) 31.7-34.6	30.13(3.56) 26.0-32.6	45.74(11.22) 34.8-57.2	36.37(9.29) 26.0-57.2
high	33.41(9.78) 26.4-44.6	28.73(6.06) 22.9-35.0	33.2(1.74) 32.2-35.2	31.78(6.25) 22.9-44.6

ELEV	76 mm	152 mm	228 mm	All trees
		52.5 degrees lat		
low	29.49(2.08) 27.1-31.0	22.45(6.87) 14.6-27.3	31.8(6.05) 25.8-37.9	27.91(6.31) 14.6-37.9
med	34.69(3.02) 31.8-37.8	37.95(5.06) 32.2-41.7	36.04(1.61) 34.2-37.2	36.23(3.37) 31.8-41.7
high	37.48(2.93) 34.3-39.95	36.92(5.31) 32.3-42.7	30.87(6.36) 24.1-36.7	35.09(5.42) 24.1-42.7
		55 degrees lat		
low	33.04(4.49) 28.3-37.1	32.64(4.89) 27.4-37.0	34.92(2.94) 32.1-37.9	33.54(3.78) 27.4-37.9
med	31.21(8.45) 21.5-37.0	36.38(1.98) 34.1-37.7	36.52(2.5) 33.7-38.2	34.7(5.22) 21.5-38.2
high	37.88(1.12) 36.7-38.97	33.99(2.21) 31.6-36.0	34.53(4.47) 29.4-37.8	35.47(3.14) 29.4-38.97
		57.5 degrees lat		
low	36.1(2.19) 33.7-38.0	33.75(0.69) 33.1-34.5	29.88(5.0) 24.1-32.8	33.24(3.87) 24.1-38.0
med	33.76(1.18) 32.5-34.8	33.75(4.21) 29.6-38.0	33.32(4.11) 29.8-37.8	33.61(3.01) 29.6-38.0
high	27.41(4.02) 24.9-32.0	33.3(5.7) 26.8-37.6	33.51(3.98) 31.2-38.1	31.41(5.01) 24.9-38.1
		60 degrees lat		
low	32.19(0.93) 31.1-32.8	32.15(0.44) 31.7-32.6	30.75(1.16) 29.6-31.9	31.7(1.05) 29.6-32.8
med	32.32(2.99) 29.2-35.2	33.8(1.29) 32.5-35.1	32.71(3.22) 29.0-34.8	32.95(2.38) 29.0-35.2
high	30.5(3.17) 27.7-33.96	34.67(2.66) 31.6-36.3	31.5(2.41) 29.6-34.2	32.23(3.05) 27.7-36.3
pooled	32.52(4.4) 21.5-44.6	32.93(4.52) 14.6-44.7	33.13(4.56) 24.1-57.2	32.86(4.48) 14.6-57.2

SUMMARIES BY LAT, ELEV AND DIAM -- LATIFOLIA/LATERAL ROOT

RADIAL LUMEN DIAMETER

ELEV	76 mm	152 mm	228 mm	All trees
		40 degrees lat		
low	35.43(2.61) 33.5-38.4	34.35(6.23) 29.6-41.4	28.33(3.76) 25.6-32.6	32.7(5.09) 25.6-41.4
med	25.08(4.75) 20.2-29.7	27.99(1.91) 25.9-29.6	28.6(2.33) 26.3-31.0	27.22(3.25) 20.2-31.0
high	28.28(1.97) 26.5-30.4	27.88(2.92) 25.7-31.2	31.07(3.57) 27.0-33.6	29.08(2.92) 25.7-33.6
		42.5 degrees lat		
low	27.92(1.86) 26.5-30.0	29.55(5.85) 25.2-36.2	26.53(0.10) 26.5-26.6	28.0(3.34) 25.2-36.2
med	24.75(1.88) 22.6-26.1	35.07(1.43) 33.9-36.6	30.01(0.77) 29.1-30.5	29.94(4.64) 22.6-36.6
high	28.93(2.11) 27.4-31.3	25.76(4.47) 22.1-30.7	25.78(0.81) 25.3-26.7	26.83(2.96) 22.1-31.3
		45 degrees lat		
low	24.07(2.79) 21.1-26.6	31.0(2.34) 28.7-33.3	28.38(5.66) 22.6-33.9	27.82(4.53) 21.1-33.9
med	31.19(3.54) 27.1-33.7	29.75(0.80) 29.1-30.7	30.22(0.81) 29.4-31.0	30.39(1.96) 27.1-33.7
high	29.49(2.73) 26.7-32.1	30.06(2.09) 28.4-32.4	31.32(2.13) 29.0-33.1	30.29(2.18) 26.7-33.1
		47.5 degrees lat		
low	31.44(2.87) 28.4-34.1	31.43(4.68) 26.2-35.2	27.01(3.19) 24.2-30.5	29.96(3.87) 24.2-35.2
med	27.98(1.88) 26.1-29.9	28.48(2.35) 26.2-30.9	30.66(2.39) 27.9-32.4	29.04(2.28) 26.1-32.4
high	31.18(4.45) 27.5-36.1	28.03(0.65) 27.4-28.7	31.29(2.92) 29.5-34.7	30.17(3.12) 27.4-36.1
		50 degrees lat		
low	29.76(5.29) 26.2-35.8	28.8(3.18) 25.2-31.2	31.99(1.89) 30.2-34.0	30.18(3.52) 25.2-35.8
med	30.66(1.93) 28.5-32.2	26.81(3.5) 22.8-29.2	42.82(10.81) 32.5-54.0	33.43(9.25) 22.8-54.0
high	29.45(10.64) 21.0-41.4	25.38(5.8) 19.3-30.9	30.39(1.54) 29.0-32.1	28.41(6.53) 19.3-41.4

ELEV	76 mm	152 mm	228 mm	All trees
		52.5 degrees lat		
low	26.62(2.16) 24.1-27.9	19.78(6.43) 12.5-24.8	28.53(5.65) 22.5-33.7	24.98(5.95) 12.5-33.7
med	31.83(3.55) 28.6-35.7	34.99(6.1) 28.0-39.3	33.85(1.67) 32.0-35.1	33.56(3.88) 28.0-39.3
high	35.02(3.46) 31.2-37.8	34.32(5.87) 28.9-40.6	28.16(6.79) 20.8-34.2	32.5(5.81) 20.8-40.6
		55 degrees lat		
low	30.45(4.94) 25.1-34.8	29.44(4.94) 24.1-33.9	32.55(2.97) 29.7-35.6	30.82(4.04) 24.1-35.6
med	28.57(8.06) 19.3-33.7	33.68(1.8) 31.7-35.3	34.26(2.51) 31.4-36.0	32.17(5.1) 19.3-36.0
high	34.94(0.56) 34.6-35.6	31.58(2.19) 29.2-33.6	31.51(3.9) 27.1-34.6	32.67(2.82) 27.1-35.6
		57.5 degrees lat		
low	32.87(1.75) 31.4-34.8	30.86(1.23) 29.9-32.2	26.26(4.67) 20.9-29.6	30.0(3.9) 20.9-34.8
med	31.15(1.21) 30.1-32.5	31.18(4.62) 26.5-35.7	29.85(4.32) 26.6-34.8	30.73(3.29) 26.5-35.7
high	24.08(4.93) 20.6-29.7	30.05(5.71) 23.6-34.3	30.0(5.57) 25.1-36.0	28.04(5.55) 20.6-36.0
		60 degrees lat		
low	29.91(0.97) 28.8-30.6	29.56(0.24) 29.4-29.8	28.18(0.85) 27.2-28.7	29.22(1.03) 27.2-30.6
med	30.03(2.94) 27.0-32.9	30.83(0.90) 30.1-31.8	30.19(2.99) 26.7-32.0	30.35(2.18) 26.7-32.9
high	28.02(3.36) 25.6-31.8	31.83(2.89) 28.5-33.9	28.88(2.81) 26.4-31.9	29.57(3.14) 25.6-33.9
pooled	29.6(4.43) 19.3-41.4	29.94(4.58) 12.5-41.4	30.25(4.59) 20.8-54.0	29.93(4.52) 12.5-54.0

TREE-AVERAGE ANALYSIS FOR MURRAYANA/STEMWOOD

This section presents the results from analysis of variance. Latewood and earlywood are mixed together as in pulping. Results are presented for 11 variables and the appropriate summary tables follow where needed. If there were no significant differences, the pooled values are given here. All tests were done at the 5% level.

1. FIBER LENGTH

   there were no significant differences -- pooled values are
   ave = 2.81
   std = 0.40 (range : 2.0 - 3.5)

2. MICROFIBRIL ANGLE

   the latitude means were significantly different

3. LATEWOOD PERCENTAGE

   the latitude means were significantly different

4. RESIN CANAL NUMBER

   the latitude means and the diameter means were both significantly different

5. RESIN CANAL DIAMETER

   the latitude means were significantly different

6. TANGENTIAL CELL DIAMETER

   the latitude means were significantly different

7. TANGENTIAL LUMEN DIAMETER

   there were no significant differences -- pooled values are
   ave = 27.48
   std = 3.77 (range : 22 - 38.5)

8. RADIAL WALL THICKNESS

   the latitude means were significantly different

9. RADIAL CELL DIAMETER

   the latitude means were significantly different

10. RADIAL LUMEN DIAMETER

    the latitude means were significantly different

11. TANG. WALL THICKNESS

    the LxD interaction was significant

SUMMARIES BY LATITUDE -- MURRAYANA/STEMWOOD

LAT	FIBER ANGLE	LW PERCENT	RESIN CANAL DIAM
37.5	21.16(1.18) 19.5-23.3	15.01(2.55) 11.1-19.6	68.41(5.21) 61.0-76.95
40	28.24(2.85) 23.9-31.7	19.13(1.88) 15.7-22.3	71.76(5.42) 58.9-76.9
42.5	23.34(2.58) 19.95-27.3	17.24(3.11) 12.8-22.96	77.58(3.52) 72.9-84.95
45	28.64(4.58) 25.6-39.5	17.22(2.66) 13.9-21.2	75.4(5.0) 67.99-84.4

LAT	TANGENTIAL CELL DIAM	RADIAL WALL THICKNESS
37.5	34.15(1.99) 30.2-36.7	2.63(0.24) 2.3-2.9
40	34.53(4.4) 29.2-43.7	2.69(0.26) 2.4-3.2
42.5	29.51(2.01) 26.5-31.9	2.32(0.28) 1.7-2.6
45	32.0(4.66) 26.7-42.6	2.41(0.29) 2.2-3.1

LAT	RADIAL CELL DIAM	RADIAL LUMEN DIAM
37.5	34.4(2.13) 30.7-37.1	30.44(2.54) 26.5-33.5
40	35.51(4.26) 29.3-43.6	31.36(4.49) 25.2-39.7
42.5	29.93(2.16) 27.6-33.2	26.31(1.9) 24.1-29.3
45	30.13(5.26) 25.9-42.98	26.2(4.99) 22.0-38.7

SUMMARIES BY LATITUDE AND DIAM -- MURRAYANA/STEMWOOD

RESIN CANAL NUMBER

LAT	76 mm dbh	152 mm dbh	228 mm dbh	All
37.5	44.23(9.34) 36.2-54.5	35.69(7.99) 27.6-43.6	37.35(7.43) 32.3-45.9	39.09(8.18) 27.6-54.5
40	32.54(2.53) 29.7-34.6	24.17(7.64) 15.5-29.9	34.89(1.91) 33.0-36.8	30.53(6.4) 15.5-36.8
42.5	41.03(3.78) 37.1-44.6	35.76(3.88) 32.98-40.2	35.12(3.54) 32.3-39.1	37.31(4.28) 32.3-44.6
45	37.06(6.8) 31.2-54.5	33.49(0.98) 32.4-34.3	31.95(5.76) 26.0-37.5	34.17(4.65) 26.0-42.4
All	38.72(6.8) 29.7-54.5	32.28(7.07) 15.5-43.6	34.83(4.8) 26.0-45.9	35.27(6.69) 15.5-54.5

TANG. WALL THICKNESS

LAT	76 mm dbh	152 mm dbh	228 mm dbh
37.5	1.83(0.32) 1.6-2.2	2.13(0.15) 2.0-2.3	1.93(0.15) 1.8-2.1
40	2.4(0.36) 2.0-2.7	1.97(0.31) 1.7-2.3	1.73(0.15) 1.6-1.9
42.5	1.63(0.38) 1.2-1.9	1.83(0.06) 1.8-1.9	1.87(0.12) 1.8-2.0
45	1.83(0.23) 1.7-2.1	2.2(0.27) 1.9-2.4	1.7(0.20) 1.5-1.9

TREE-AVERAGE ANALYSIS FOR MURRAYANA/STUMP

This section presents the results from analysis of variance. Latewood and earlywood are mixed together as in pulping. Results are presented for 11 variables and the appropriate summary tables follow where needed. If there were no significant differences, the pooled values are given here. All tests were done at the 5% level.

1. FIBER LENGTH

the LxD interaction was significant

2. MICROFIBRIL ANGLE

there were no significant differences -- pooled values are
ave = 32.54
std = 4.9 (range : 20.8 - 42.4)

3. LATEWOOD PERCENTAGE

there were no significant differences -- pooled values are
ave = 13.14
std = 3.2 (range : 8.0 - 21.0)

4. RESIN CANAL NUMBER

there were no significant differences -- pooled values are
ave = 35.19
std = 6.16 (range : 24.0 - 48.0)

5. RESIN CANAL DIAMETER

there were no significant differences -- pooled values are
ave = 73.67
std = 7.4 (range : 59.0 - 89.0)

6. TANGENTIAL CELL DIAMETER

the LxD interaction was significant

7. TANGENTIAL LUMEN DIAMETER

the LxD interaction was significant

8. RADIAL WALL THICKNESS

there were no significant differences -- pooled values are
ave = 2.15
std = 0.43 (range : 1.59 - 2.88)

9. RADIAL CELL DIAMETER

the LxD interaction was significant

10. RADIAL LUMEN DIAMETER

---

the LxD interaction was significant

11. TANG. WALL THICKNESS

---

there were no significant differences -- pooled values are

ave = 1.60

std = 0.37 (range : 1.05 - 2.27)

SUMMARIES BY LATITUDE AND DIAM -- MURRAYANA/STUMP

FIBER LENGTH

LAT	76 mm dbh	152 mm dbh	228 mm dbh
37.5	2.64(0.08) 2.6-2.7	2.8(0.37) 2.4-3.1	2.44(0.23) 2.2-2.7
40	2.82(0.18) 2.6-3.0	2.01(0.21) 1.8-2.2	2.8(0.58) 2.3-3.4
42.5	2.39(0.46) 2.1-2.9	2.89(0.36) 2.5-3.2	2.58(0.49) 2.0-2.9
45	2.87(0.77) 2.0-3.5	2.08(0.22) 1.9-2.3	2.94(0.49) 2.4-3.3

TANGENTIAL CELL DIAMETER

LAT	76 mm dbh	152 mm dbh	228 mm dbh
37.5	31.55(3.13) 29.5-35.2	28.44(1.52) 26.9-29.9	34.11(2.92) 30.9-36.5
40	29.6(0.73) 28.9-30.3	40.45(1.85) 39.3-42.6	33.56(4.36) 30.4-38.5
42.5	30.91(4.83) 25.5-34.6	26.9(3.53) 23.2-30.2	31.01(1.1) 29.7-31.7
45	40.78(10.13) 34.6-52.5	31.22(4.25) 26.9-35.4	30.85(4.69) 27.6-36.2

TANGENTIAL LUMEN DIAMETER

LAT	76 mm dbh	152 mm dbh	228 mm dbh
37.5	26.75(2.36) 25.1-29.5	23.56(2.17) 21.1-25.2	30.39(2.57) 27.4-32.2
40	25.42(1.05) 24.3-26.3	36.38(1.55) 34.95-38.0	29.79(4.85) 25.7-35.2
42.5	27.52(4.71) 22.3-31.4	21.91(3.86) 18.0-25.7	26.25(1.65) 24.4-27.3
45	35.28(10.08) 29.2-46.9	27.32(3.54) 23.5-30.5	26.86(3.49) 24.3-30.8

RADIAL CELL DIAMETER

LAT	76 mm dbh	152 mm dbh	228 mm dbh
37.5	31.49(5.2) 28.1-37.5	32.0(2.2) 29.9-34.3	34.7(2.48) 32.6-37.4
40	30.45(0.75) 29.7-31.2	44.3(1.35) 43.0-45.7	37.28(3.5) 35.1-41.3
42.5	28.55(5.04) 23.1-33.0	29.31(2.2) 27.0-31.4	32.35(2.31) 29.96-34.6
45	40.71(11.31) 33.0-53.7	29.4(6.65) 22.4-35.7	28.08(4.2) 24.9-32.8

RADIAL LUMEN DIAMETER

LAT	76 mm dbh	152 mm dbh	228 mm dbh
37.5	28.17(5.24) 24.7-34.2	29.12(1.55) 27.7-30.8	31.85(1.56) 30.3-33.4
40	27.42(0.36) 27.1-27.8	41.16(1.49) 39.6-42.6	34.3(4.05) 31.6-38.96
42.5	25.98(4.47) 21.0-29.7	25.32(2.25) 22.8-27.2	28.53(2.84) 25.6-31.2
45	36.9(10.79) 28.7-49.15	26.32(6.17) 19.96-32.3	25.2(3.02) 22.7-28.6

TREE-AVERAGE ANALYSIS FOR MURRAYANA/TAP ROOT

This section presents the results from analysis of variance. Latewood and earlywood are mixed together as in pulping. Results are presented for 11 variables and the appropriate summary tables follow where needed. If there were no significant differences, the pooled values are given here. All tests were done at the 5% level.

1. FIBER LENGTH

there were no significant differences -- pooled values are
ave = 2.39
std = 0.39 (range : 1.82 - 3.39)

2. MICROFIBRIL ANGLE

there were no significant differences -- pooled values are
ave = 33.33
std = 4.2 (range : 26.84 - 43.2)

3. LATEWOOD PERCENTAGE

there were no significant differences -- pooled values are
ave = 12.78
std = 3.1 (range : 8.0 - 20.0)

4. RESIN CANAL NUMBER

there were no significant differences -- pooled values are
ave = 34.25
std = 7.28 (range : 16.0 - 52.0)

5. RESIN CANAL DIAMETER

the latitude means were significantly different

6. TANGENTIAL CELL DIAMETER

the LxD interaction was significant

7. TANGENTIAL LUMEN DIAMETER

the LxD interaction was significant

8. RADIAL WALL THICKNESS

the diameter means were significantly different --

76 mm dbh : ave = 1.82
std = 0.33 (range : 1.2 - 2.3)

152 mm dbh : ave = 2.26
std = 0.42 (range : 1.7 - 3.1)

228 mm dbh : ave = 2.03
std = 0.40 (range : 1.6 - 2.8)

9. RADIAL CELL DIAMETER

---

the latitude means were significantly different

10. RADIAL LUMEN DIAMETER

---

the latitude means were significantly different

11. TANG. WALL THICKNESS

---

the LxD interaction was significant

SUMMARIES BY LATITUDE -- MURRAYANA/TAP ROOT

LAT	RESIN CANAL DIAM	RADIAL CELL DIAM
37.5	67.44(4.16) 62.0-75.0	32.32(4.17) 28.0-39.6
40	73.89(5.47) 65.0-83.0	35.85(5.83) 30.0-46.0
42.5	74.44(6.25) 66.0-88.0	28.39(3.78) 23.7-34.1
45	76.11(3.95) 71.0-82.0	30.44(7.07) 21.2-42.3

LAT	RADIAL LUMEN DIAM
37.5	29.28(4.27) 25.7-36.3
40	32.78(6.05) 25.7-42.7
42.5	25.19(4.03) 19.2-31.0
45	27.13(7.29) 17.0-38.9

SUMMARIES BY LATITUDE AND DIAM -- MURRAYANA/TAP ROOT

TANGENTIAL CELL DIAMETER

LAT	76 mm dbh	152 mm dbh	228 mm dbh
37.5	30.62(5.88) 25.3-36.96	28.27(1.12) 27.0-29.1	34.51(4.12) 30.5-38.7
40	30.55(2.66) 28.7-33.6	38.33(6.62) 31.1-44.1	33.72(2.16) 32.4-36.2
42.5	29.75(5.83) 25.8-36.5	25.48(3.15) 22.2-28.5	27.27(4.54) 24.6-32.5
45	37.01(4.45) 33.6-42.0	28.78(1.89) 26.6-30.0	28.43(5.22) 24.5-34.4

TANGENTIAL LUMEN DIAMETER

LAT	76 mm dbh	152 mm dbh	228 mm dbh
37.5	26.57(5.87) 21.0-32.7	23.82(2.13) 21.4-25.4	30.51(3.15) 27.2-33.5
40	26.8(3.02) 24.9-30.3	33.82(7.01) 26.1-39.8	29.92(2.48) 27.95-32.7
42.5	26.74(6.44) 22.3-34.1	20.28(3.74) 16.1-23.3	23.3(4.27) 20.4-28.2
45	32.93(4.17) 29.3-37.5	24.84(1.59) 23.1-26.2	23.95(5.39) 19.0-29.7

TANG. WALL THICKNESS

LAT	76 mm dbh	152 mm dbh	228 mm dbh
37.5	1.31(0.36) 1.1-1.7	1.68(0.13) 1.6-1.8	1.57(0.07) 1.5-1.6
40	1.45(0.55) 1.1-2.1	1.81(0.32) 1.6-2.2	1.35(0.33) 1.1-1.7
42.5	1.0(0.31) 0.7-1.3	2.32(0.24) 2.1-2.6	1.49(0.29) 1.2-1.7
45	1.49(0.30) 1.2-1.7	1.69(0.08) 1.6-1.8	1.79(0.28) 1.6-2.1

TREE-AVERAGE ANALYSIS FOR MURRAYANA/LATERAL ROOT

This section presents the results from analysis of variance. Latewood and earlywood are mixed together as in pulping. Results are presented for 11 variables and the appropriate summary tables follow where needed. If there were no significant differences, the pooled values are given here. All tests were done at the 5% level.

1. FIBER LENGTH

there were no significant differences -- pooled values are
ave = 2.17
std = 0.45 (range : 1.3 - 3.12)

2. MICROFIBRIL ANGLE

there were no significant differences -- pooled values are
ave = 34.71
std = 3.84 (range : 25.9 - 40.73)

3. LATEWOOD PERCENTAGE

there were no significant differences -- pooled values are
ave = 11.64
std = 3.03 (range : 7.0 - 20.0)

4. RESIN CANAL NUMBER

there were no significant differences -- pooled values are
ave = 33.14
std = 7.24 (range : 20.0 - 52.0)

5. RESIN CANAL DIAMETER

there were no significant differences -- pooled values are
ave = 73.03
std = 5.23 (range : 60.0 - 83.0)

6. TANGENTIAL CELL DIAMETER

the latitude means were significantly different

7. TANGENTIAL LUMEN DIAMETER

the latitude means were significantly different

8. RADIAL WALL THICKNESS

there were no significant differences -- pooled values are
ave = 1.93
std = 0.32 (range : 1.6 - 2.8)

9. RADIAL CELL DIAMETER

the LxD interaction was significant

10. RADIAL LUMEN DIAMETER

the LxD interaction was significant

11. TANG. WALL THICKNESS

there were no significant differences -- pooled values are
ave = 1.42
std = 0.30 (range : 1.0 - 2.2)

SUMMARIES BY LATITUDE -- MURRAYANA/LATERAL ROOT

LAT	TANGENTIAL CELL DIAM	TANGENTIAL LUMEN DIAM
37.5	28.78(3.17) 24.4-34.5	24.88(3.05) 21.0-30.1
40	32.99(4.59) 24.4-40.7	29.18(4.58) 20.9-37.4
42.5	27.91(3.42) 23.3-33.7	24.13(3.9) 18.1-30.5
45	31.82(5.05) 27.0-43.7	27.87(4.53) 23.4-38.1

SUMMARIES BY LATITUDE AND DIAM -- MURRAYANA/LATERAL ROOT

RADIAL CELL DIAMETER

LAT	76 mm dbh	152 mm dbh	228 mm dbh
37.5	28.69(3.11) 25.3-31.5	30.24(1.57) 29.2-32.0	31.17(4.13) 27.4-35.6
40	30.08(3.89) 25.8-33.3	38.32(5.26) 33.2-43.7	35.72(5.73) 29.3-40.4
42.5	29.39(2.41) 26.7-31.3	30.54(0.92) 29.8-31.6	29.01(2.36) 27.6-31.7
45	36.65(6.43) 31.8-43.9	27.85(5.03) 23.1-33.1	26.87(3.15) 24.1-30.3

RADIAL LUMEN DIAMETER

LAT	76 mm dbh	152 mm dbh	228 mm dbh
37.5	26.07(3.14) 22.96-29.2	27.84(1.7) 26.8-29.8	28.33(3.59) 25.3-32.3
40	26.98(3.49) 23.1-29.9	35.48(4.69) 31.2-40.5	32.85(5.3) 26.9-37.1
42.5	27.14(2.32) 24.6-29.2	27.26(0.58) 26.6-27.8	25.99(2.21) 24.2-28.5
45	33.74(5.2) 29.6-39.6	24.8(4.75) 20.6-29.96	23.93(2.8) 21.8-27.1

TREE-AVERAGE ANALYSIS FOR LAT VS MUR/STEMWOOD

This section presents the results from analysis of variance for the latitudes the two varieties have in common (40, 42.5 and 45). Latewood and earlywood are mixed together as in pulping. Results are presented for 11 variables and the needed summary tables follow. If there were no significant differences, the pooled values are given here. All tests were done at the 5% level.

1. FIBER LENGTH

   the Variety x Diam interaction was significant

2. MICROFIBRIL ANGLE

   the VxLxD and VxL interactions were significant

3. LATEWOOD PERCENTAGE

   the variety means were significantly different --
   (n=27 for each variety)

   Latifolia : ave = 15.77
   std = 3.06 (range : 10.24 - 22.37)

   Murrayana : ave = 17.86
   std = 2.66 (range : 12.83 - 22.96)

4. RESIN CANAL NUMBER

   the VxLxD interaction was significant

5. RESIN CANAL DIAMETER

   there were no significant differences -- pooled values are
   ave = 74.32
   std = 5.75 (range : 58.91 - 84.95)

6. TANGENTIAL CELL DIAMETER

   there were no significant differences -- pooled values are
   ave = 32.86
   std = 3.56 (range : 26.54 - 43.72)

7. TANGENTIAL LUMEN DIAMETER

   there were no significant differences -- pooled values are
   ave = 27.58
   std = 3.41 (range : 22.04 - 38.59)

8. RADIAL [illegible] WALL THICKNESS

   the LxD and VxL interactions were significant

9. RADIAL CELL DIAMETER

the VxL interaction was significant

10. RADIAL LUMEN DIAMETER

the variety as well as the latitude means were significantly different

11. TANG.. WALL THICKNESS

the variety means were significantly different and the LxD interaction was significant

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SUMMARIES BY VAR AND DIAM -- LAT VS MUR/STEMWOOD

FIBER LENGTH

DIAM	LATIFOLIA	MURRAYANA
76 mm	2.23(0.42) 1.7-2.9	2.88(0.44) 2.2-3.5
152 mm	3.07(0.35) 2.6-3.6	2.69(0.53) 2.0-3.5
228 mm	2.18(0.51) 1.6-3.0	2.81(0.42) 2.1-3.5

SUMMARIES BY VAR, LAT AND DIAM -- LAT VS MUR/STEMWOOD

MICROFIBRIL ANGLE

LAT	76 mm dbh	152 mm dbh	228 mm dbh
		Latifolia	
40	19.37(1.28)	21.43(1.68)	20.09(0.60)
	18.3-20.8	19.7-23.1	19.4-20.5
42.5	25.18(1.81)	31.85(2.11)	23.43(3.5)
	23.6-27.2	29.6-33.7	19.4-25.6
45	18.04(0.41)	18.47(0.34)	17.71(1.79)
	17.7-18.5	18.2-18.8	16.5-19.8
		Murrayana	
40	25.7(1.56)	30.6(0.30)	28.42(3.44)
	23.9-26.9	30.3-30.9	24.8-31.7
42.5	25.12(1.88)	21.46(1.61)	23.44(3.25)
	23.8-27.3	19.95-23.2	20.8-27.1
45	30.93(7.52)	28.17(3.46)	26.82(1.54)
	25.6-39.5	26.1-32.2	25.9-28.6

RESIN CANAL NUMBER

LAT	76 mm dbh	152 mm dbh	228 mm dbh
		Latifolia	
40	39.03(3.93)	31.8(5.65)	29.91(1.89)
	35.8-43.4	25.4-36.2	27.9-31.6
42.5	33.24(5.72)	30.24(3.97)	39.07(1.49)
	26.99-38.2	25.8-33.5	37.5-40.4
45	39.81(8.76)	33.73(6.59)	36.75(2.67)
	30.4-47.8	27.7-40.8	33.9-39.2
		Murrayana	
40	32.54(2.53)	24.17(7.64)	34.89(1.91)
	29.7-34.6	15.5-29.9	33.0-36.8
42.5	41.03(3.78)	35.76(3.88)	35.12(3.54)
	37.1-44.6	32.98-40.2	32.3-39.1
45	37.06(5.63)	33.49(0.98)	31.95(5.76)
	31.2-42.4	32.4-34.3	26.0-37.5

RADIAL WALL THICKNESS

LAT	76 mm dbh	152 mm dbh	228 mm dbh
		Latifolia	
40	2.88(0.22) 2.7-3.1	2.92(0.29) 2.6-3.2	2.33(0.31) 1.99-2.6
42.5	2.77(0.61) 2.1-3.2	2.64(0.22) 2.4-2.8	3.12(0.33) 2.8-3.4
45	2.87(0.26) 2.6-3.1	2.76(0.25) 2.6-3.1	3.05(0.04) 3.0-3.08
		Murrayana	
40	2.94(0.27) 2.6-3.2	2.62(0.09) 2.6-2.7	2.51(0.17) 2.4-2.7
42.5	2.20(0.50) 1.7-2.6	2.37(0.13) 2.3-2.5	2.4(0.14) 2.3-2.5
45	2.3(0.13) 2.2-2.4	2.69(0.35) 2.4-3.1	2.24(0.08) 2.2-2.3

RADIAL WALL THICKNESS

LAT	76 mm dbh	152 mm dbh	228 mm dbh
		Latifolia	
40	2.26(0.21) 2.1-2.5	2.23(0.25) 1.99-2.5	1.75(0.25) 1.5-1.9
42.5	2.2(0.51) 1.6-2.5	2.04(0.21) 1.8-2.2	2.31(0.29) 2.1-2.6
45	2.33(0.26) 2.0-2.5	2.11(0.26) 1.96-2.4	2.34(0.18) 2.1-2.5
		Murrayana	
40	2.44(0.34) 2.1-2.7	2.03(0.26) 1.8-2.3	1.78(0.18) 1.7-1.98
42.5	1.64(0.38) 1.2-1.9	1.88(0.07) 1.8-1.95	1.91(0.14) 1.8-2.1
45	1.89(0.23) 1.8-2.2	2.24(0.26) 1.95-2.4	1.75(0.17) 1.6-1.9

SUMMARIES BY VAR AND LAT --- LAT VS MUR/STEMWOOD

RADIAL CELL DIAMETER

LAT	LATIFOLIA	MURRAYANA
40	34.42(2.89) 30.4-38.8	35.51(4.26) 29.3-43.6
42.5	34.81(3.0) 31.6-39.6	29.93(2.16) 27.6-33.2
45	34.03(2.16) 31.8-37.5	30.13(5.26) 25.9-43.0

RADIAL LUMEN DIAMETER

LAT	LATIFOLIA	MURRAYANA	ALL
40	30.26(2.75) 26.5-34.4	31.36(4.49) 25.2-39.7	30.81(3.65) 25.2-39.7
42.5	30.44(3.25) 26.7-35.5	26.31(1.9) 24.1-29.3	28.37(3.34) 24.1-35.5
45	29.51(2.22) 27.4-32.9	26.2(4.99) 22.0-38.7	27.86(4.11) 22.0-38.7
ALL	30.07(2.69) 26.5-35.5	27.96(4.58) 22.0-39.7	---

TREE-AVERAGE ANALYSIS FOR LAT VS MUR/STUMP

This section presents the results from analysis of variance for the latitudes the two varieties have in common (40, 42.5 and 45). Latewood and earlywood are mixed together as in pulping. Results are presented for 11 variables and the needed summary tables follow. If there were no significant differences, the pooled values are given here. All tests were done at the 5% level.

1. FIBER LENGTH

there were no significant differences -- pooled values are
ave = 2.57
std = 0.46 (range : 1.78 - 3.5)

2. MICROFIBRIL ANGLE

there were no significant differences -- pooled values are
ave = 32.54
std = 4.36 (range : 24.24 - 42.36)

3. LATEWOOD PERCENTAGE

there were no significant differences -- pooled values are
ave = 13.19
std = 3.4 (range : 8.0 - 21.0)

4. RESIN CANAL NUMBER

there were no significant differences -- pooled values are
ave = 37.09
std = 7.54 (range : 24.0 - 52.0)

5. RESIN CANAL DIAMETER

there were no significant differences -- pooled values are
ave = 73.65
std = 6.9 (range : 58.0 - 89.0)

6. TANGENTIAL CELL DIAMETER

the VxLxD interaction was significant

7. TANGENTIAL LUMEN DIAMETER

the VxLxD interaction was significant

8. RADIAL WALL THICKNESS

the variety means were significantly different and the LxD interaction was significant

9. RADIAL CELL DIAMETER

the VxLxD, LxD and VxL interactions were significant

10. RADIAL LUMEN DIAMETER

the VxLxD, LxD and VxL interactions were significant

11. TANG. WALL THICKNESS

the variety means were significantly different and the LxD interaction was significant

SUMMARIES BY VAR, LAT AND DIAM -- LAT VS MUR/STUMP

TANGENTIAL CELL DIAMETER

LAT	76 mm dbh	152 mm dbh	228 mm dbh
		Latifolia	
40	31.7(3.99) 27.4-35.2	28.48(1.63) 26.8-30.0	32.04(3.29) 28.5-35.0
42.5	28.08(2.46) 25.4-30.3	32.29(2.32) 30.3-34.8	32.22(2.55) 29.7-34.8
45	31.56(3.06) 28.3-34.4	30.87(2.71) 28.7-33.9	34.01(3.72) 30.1-37.4
		Murrayana	
40	29.6(0.73) 28.9-30.3	40.5(1.85) 39.3-42.6	33.56(4.36) 30.4-38.5
42.5	30.91(4.83) 25.5-34.6	26.9(3.53) 23.2-30.2	31.01(1.1) 29.7-31.7
45	40.78(10.13) 34.6-52.5	31.22(4.25) 26.9-35.4	30.85(4.69) 27.6-36.2

TANGENTIAL LUMEN DIAMETER

LAT	76 mm dbh	152 mm dbh	228 mm dbh
		Latifolia	
40	26.26(3.49) 22.7-29.7	23.4(2.64) 20.4-25.5	28.59(3.82) 25.0-32.6
42.5	23.71(3.38) 20.2-26.9	26.52(0.70) 25.8-27.2	26.73(3.26) 23.1-29.4
45	26.17(3.38) 22.3-28.7	25.59(2.66) 23.1-28.4	29.17(3.51) 25.3-32.1
		Murrayana	
40	25.42(1.05) 24.3-26.3	36.38(1.55) 34.95-38.0	29.79(4.85) 25.7-35.2
42.5	27.52(4.71) 22.3-31.4	21.91(3.86) 18.0-25.7	26.25(1.65) 24.4-27.3
45	35.28(10.08) 29.2-46.9	27.32(3.54) 23.5-30.5	26.86(3.49) 24.3-30.8

RADIAL WALL THICKNESS

LAT	76 mm dbh	152 mm dbh	228 mm dbh
		Latifolia	
40	2.72(0.38) 2.3-3.1	2.54(0.54) 2.2-3.2	1.72(0.51) 1.2-2.2
42.5	2.18(0.47) 1.7-2.6	2.89(1.09) 2.2-4.1	2.75(0.53) 2.2-3.3
45	2.69(0.36) 2.3-2.97	2.64(0.21) 2.4-2.8	2.42(0.22) 2.2-2.7
		Murrayana	
40	2.09(0.35) 1.7-2.3	2.04(0.32) 1.7-2.3	1.88(0.38) 1.7-2.3
42.5	1.69(0.15) 1.6-1.9	2.5(0.23) 2.2-2.7	2.38(0.28) 2.2-2.7
45	2.55(0.33) 2.2-2.8	1.95(0.41) 1.7-2.4	2.0(0.60) 1.6-2.7

RADIAL CELL DIAMETER

LAT	76 mm dbh	152 mm dbh	228 mm dbh
		Latifolia	
40	31.54(3.95) 27.4-35.3	29.95(2.05) 28.2-32.2	34.18(3.29) 30.8-37.3
42.5	29.37(1.62) 28.0-31.2	34.94(3.63) 30.9-37.9	33.9(0.11) 33.8-33.96
45	32.37(2.67) 29.96-35.2	31.0(2.81) 28.4-34.0	34.86(3.67) 30.8-37.9
		Murrayana	
40	30.45(0.75) 29.7-31.2	44.3(1.35) 43.0-45.7	37.28(3.5) 35.1-41.3
42.5	28.55(5.04) 23.1-33.0	29.31(2.2) 27.0-31.4	32.35(2.31) 29.96-34.6
45	40.71(11.31) 33.0-53.7	29.4(6.65) 22.4-35.7	28.08(4.2) 24.9-32.8

RADIAL LUMEN DIAMETER

LAT	76 mm dbh	152 mm dbh	228 mm dbh
		Latifolia	
40	27.43(3.2) 24.6-30.9	25.96(1.64) 24.8-27.8	31.49(3.53) 28.1-35.2
42.5	25.85(2.08) 23.9-28.0	30.2(2.39) 27.5-31.6	29.77(0.21) 29.6-30.0
45	28.25(2.42) 26.2-30.9	27.14(2.4) 24.8-29.6	30.56(3.73) 26.4-33.6
		Murrayana	
40	27.42(0.36) 27.1-27.8	41.16(1.49) 39.6-42.6	34.3(4.05) 31.6-38.96
42.5	25.98(4.47) 21.0-29.7	25.3(2.25) 22.8-27.2	28.53(2.84) 25.6-31.2
45	36.94(10.79) 28.7-49.2	26.32(6.17) 19.96-32.3	25.2(3.02) 22.7-28.6

TANG. WALL THICKNESS

LAT	76 mm dbh	152 mm dbh	228 mm dbh
		Latifolia	
40	2.06(0.60) 1.4-2.6	2.0(0.26) 1.7-2.2	1.34(0.28) 1.1-1.6
42.5	1.76(0.27) 1.6-2.1	2.37(0.74) 1.7-3.2	2.05(0.15) 1.9-2.2
45	2.06(0.16) 1.9-2.2	1.93(0.24) 1.8-2.2	2.15(0.05) 2.09-2.19
		Murrayana	
40	1.52(0.34) 1.1-1.7	1.57(0.13) 1.5-1.7	1.49(0.29) 1.2-1.7
42.5	1.29(0.34) 1.1-1.7	2.0(0.15) 1.8-2.1	1.91(0.27) 1.7-2.2
45	1.89(0.56) 1.2-2.3	1.54(0.26) 1.2-1.7	1.44(0.60) 1.1-2.1

TREE-AVERAGE ANALYSIS FOR LAT VS MUR/TAP ROOT

This section presents the results from analysis of variance for the latitudes the two varieties have in common (40, 42.5 and 45). Latewood and earlywood are mixed together as in pulping. Results are presented for 11 variables and the needed summary tables follow. If there were no significant differences, the pooled values are given here. All tests were done at the 5% level.

1. FIBER LENGTH

the variety means were significantly different -- n=27

Latifolia : ave = 2.20
std = 0.33 (range : 1.66 - 3.01)

Murrayana : ave = 2.42
std = 0.41 (range : 1.82 - 3.39)

2. MICROFIBRIL ANGLE

there were no significant differences -- pooled values are
ave = 33.32
std = 4.11 (range : 24.0 - 41.6)

3. LATEWOOD PERCENTAGE

there were no significant differences -- pooled values are
ave = 12.33
std = 3.08 (range : 6.0 - 20.0)

4. RESIN CANAL NUMBER

there were no significant differences -- pooled values are
ave = 35.87
std = 8.56 (range : 16.0 - 56.0)

5. RESIN CANAL DIAMETER

there were no significant differences -- pooled values are
ave = 73.89
std = 6.0 (range : 60.0 - 88.0)

6. TANGENTIAL CELL DIAMETER

the VxLxD and VxL interactions were significant

7. TANGENTIAL LUMEN DIAMETER

the VxLxD and VxL interactions were significant

8. RADIAL WALL THICKNESS

the diameter means were significantly different -- n=18

76 mm : ave = 1.93	152 mm : ave = 2.35	228 mm : ave = 2.08
std = 0.35	std = 0.45	std = 0.42
1.2-2.5	1.8-3.2	1.6-3.2

9. RADIAL CELL DIAMETER

---

the VxLxD, LxD and VxL interactions were significant

10. RADIAL LUMEN DIAMETER

---

the VxLxD, LxD and VxL interactions were significant

11. TANG. WALL THICKNESS

---

the VxLxD interaction was significant

SUMMARIES BY VAR, LAT AND DIAM -- LAT VS MUR/TAP ROOT

TANGENTIAL CELL DIAMETER

LAT	76 mm dbh	152 mm dbh	228 mm dbh
		Latifolia	
40	30.02(5.16) 25.0-35.4	29.83(3.4) 26.0-32.5	31.08(3.03) 29.2-34.6
42.5	28.14(3.64) 25.6-32.3	35.99(5.19) 30.0-39.1	33.29(1.14) 32.6-34.6
45	32.78(4.0) 28.6-36.5	31.8(1.93) 29.6-33.3	31.16(1.84) 29.7-33.2
		Murrayana	
40	30.55(2.66) 28.7-33.6	38.33(6.62) 31.1-44.1	33.72(2.16) 32.4-36.2
42.5	29.75(5.83) 25.8-36.5	25.48(3.15) 22.2-28.5	27.27(4.54) 24.6-32.5
45	37.01(4.45) 33.6-42.0	28.78(1.89) 26.6-30.0	28.43(5.22) 24.5-34.4

TANGENTIAL LUMEN DIAMETER

LAT	76 mm dbh	152 mm dbh	228 mm dbh
		Latifolia	
40	25.93(5.48) 21.2-31.96	24.59(4.15) 20.8-29.0	27.55(2.77) 25.8-30.7
42.5	23.85(3.8) 21.2-28.2	31.81(5.41) 25.6-35.5	28.59(2.56) 26.3-31.4
45	28.55(3.46) 25.1-32.0	26.36(1.36) 25.1-27.8	26.66(1.78) 25.3-28.7
		Murrayana	
40	26.8(3.02) 24.9-30.3	33.82(7.01) 26.1-39.8	29.92(2.48) 27.95-32.7
42.5	26.74(6.44) 22.3-34.1	20.28(3.74) 16.1-23.3	23.3(4.27) 20.4-28.2
45	32.93(4.17) 29.3-37.5	24.84(1.59) 23.1-26.2	23.95(5.39) 19.0-29.7

RADIAL CELL DIAMETER

LAT	76 mm dbh	152 mm dbh	228 mm dbh
		Latifolia	
40	31.06(6.74) 23.9-37.3	31.26(2.54) 28.5-33.4	33.33(3.08) 29.9-35.9
42.5	28.69(2.93) 25.7-31.6	38.31(3.45) 34.4-40.9	33.02(1.82) 31.1-34.7
45	32.77(2.9) 30.0-35.8	32.49(1.69) 30.6-33.7	33.54(1.51) 31.8-34.5
		Murrayana	
40	32.5(2.94) 30.6-35.9	39.9(8.64) 30.0-46.0	35.17(3.25) 32.3-38.7
42.5	28.54(4.77) 23.7-33.2	27.41(3.79) 24.3-31.6	29.23(4.2) 26.7-34.1
45	37.91(3.99) 34.6-42.3	28.1(4.68) 23.4-32.8	25.31(5.51) 21.2-31.6

RADIAL LUMEN DIAMETER

LAT	76 mm dbh	152 mm dbh	228 mm dbh
		Latifolia	
40	28.1(6.89) 21.3-35.1	28.28(2.03) 26.1-30.1	31.02(3.03) 27.7-33.7
42.5	25.48(3.02) 22.5-28.5	35.22(3.66) 31.0-37.5	29.16(2.16) 27.7-31.6
45	29.69(2.49) 27.6-32.4	28.12(0.82) 27.2-28.7	30.11(1.39) 28.5-30.9
		Murrayana	
40	29.6(3.69) 26.4-33.6	36.27(9.26) 25.7-42.7	32.46(3.67) 28.9-36.2
42.5	26.54(4.32) 22.4-31.0	22.78(4.24) 19.2-27.5	26.25(3.92) 23.6-30.8
45	34.94(3.51) 32.3-38.9	24.73(4.78) 20.1-29.6	21.73(5.78) 17.0-28.2

TANG. WALL THICKNESS

LAT	76 mm dbh	152 mm dbh	228 mm dbh
		Latifolia	
40	1.48(0.46) 1.1-2.0	1.49(0.27) 1.2-1.7	1.16(0.11) 1.1-1.3
42.5	1.61(0.05) 1.55-1.64	1.55(0.27) 1.2-1.7	1.93(0.55) 1.5-2.6
45	1.54(0.28) 1.2-1.7	2.18(0.47) 1.7-2.6	1.71(0.06) 1.65-1.77
		Murrayana	
40	1.45(0.55) 1.1-2.1	1.81(0.32) 1.6-2.2	1.35(0.33) 1.1-1.7
42.5	1.0(0.31) 0.7-1.3	2.32(0.24) 2.1-2.6	1.49(0.29) 1.2-1.7
45	1.49(0.30) 1.2-1.7	1.69(0.08) 1.6-1.8	1.79(0.28) 1.6-2.1

TREE-AVERAGE ANALYSIS FOR LAT VS MUR/LATERAL ROOT

This section presents the results from analysis of variance for the latitudes the two varieties have in common (40, 42.5 and 45). Latewood and earlywood are mixed together as in pulping. Results are presented for 11 variables and the needed summary tables follow. If there were no significant differences, the pooled values are given here. All tests were done at the 5% level.

1. FIBER LENGTH

the variety means were significantly different -- n=27

Latifolia : ave = 1.97
std = 0.28 (range : 1.45 - 2.51)

Murrayana : ave = 2.24
std = 0.48 (range : 1.3 - 3.12)

2. MICROFIBRIL ANGLE

there were no significant differences -- pooled values are
ave = 34.89
std = 3.8 (range : 25.9 - 41.04)

3. LATEWOOD PERCENTAGE

there were no significant differences -- pooled values are
ave = 11.65
std = 3.06 (range : 6.0 - 20.0)

4. RESIN CANAL NUMBER

the variety means were significantly different -- n=27

Latifolia : ave = 36.89
std = 7.05 (range : 24.0 - 52.0)

Murrayana : ave = 32.19
std = 6.78 (range : 20.0 - 49.0)

5. RESIN CANAL DIAMETER

the variety means were significantly different -- n=27

Latifolia : ave = 70.52
std = 5.43 (range : 61.0 - 81.0)

Murrayana : ave = 74.04
std = 4.62 (range : 65.0 - 82.0)

6. TANGENTIAL CELL DIAMETER

the VxL, VXD and LxD interactions were significant

7. TANGENTIAL LUMEN DIAMETER

the VxLxD, LxD, VxD and VxL interactions were significant

8. RADIAL WALL THICKNESS

there were no significant differences -- pooled values are
ave = 1.98
std = 0.38 (range : 1.4 - 3.1)

9. RADIAL CELL DIAMETER

the LxD and VxL interactions were significant

10. RADIAL LUMEN DIAMETER

the VxLxD, LxD and VxL interactions were significant

11. TANG. WALL THICKNESS

there were no significant differences -- pooled values are
ave = 1.5
std = 0.33 (range : 1.0 - 2.6)

SUMMARIES BY VAR, LAT AND DIAM -- LAT VS MUR/LATERAL ROOT

TANGENTIAL CELL DIAMETER

LAT	76 mm dbh	152 mm dbh	228 mm dbh
		Latifolia	
40	26.61(3.22) 24.0-30.2	31.23(2.98) 27.8-33.4	31.35(1.84) 29.7-33.4
42.5	24.82(1.14) 23.5-25.6	35.88(1.88) 34.6-38.0	31.12(1.48) 29.5-32.3
45	34.7(5.28) 28.6-37.8	33.12(1.17) 32.3-34.5	33.03(1.38) 31.5-34.2
		Murrayana	
40	29.43(4.42) 24.4-32.5	36.38(4.25) 32.2-40.7	33.17(3.21) 29.5-35.3
42.5	30.4(2.97) 28.0-33.7	26.3(2.57) 23.3-28.0	27.04(4.13) 23.9-31.7
45	35.67(7.0) 30.6-43.7	29.49(3.04) 27.0-32.9	30.28(3.13) 27.6-33.7

TANGENTIAL LUMEN DIAMETER

LAT	76 mm dbh	152 mm dbh	228 mm dbh
		Latifolia	
40	23.12(3.35) 20.3-26.8	26.34(2.92) 23.4-29.3	28.11(1.54) 27.0-29.9
42.5	21.18(1.72) 19.2-22.2	32.07(1.15) 31.4-33.4	26.99(0.98) 25.96-27.9
45	30.6(4.78) 25.1-33.4	28.49(0.62) 28.0-29.2	28.3(0.95) 27.2-28.9
		Murrayana	
40	25.38(3.92) 20.9-28.1	32.65(4.44) 28.6-37.4	29.5(2.96) 26.1-31.4
42.5	27.1(3.0) 24.8-30.5	21.98(3.44) 18.1-24.7	23.3(4.34) 20.5-28.3
45	31.65(5.72) 27.3-38.1	26.01(2.89) 23.5-29.2	25.97(3.02) 23.4-29.3

RADIAL CELL DIAMETER

LAT	76 mm dbh	152 mm dbh	228 mm dbh
		Latifolia	
40	27.78(4.23)	32.18(2.83)	31.24(2.84)
	23.6-32.1	29.1-34.7	28.7-34.3
42.5	27.24(1.35)	38.11(1.75)	32.76(1.07)
	25.7-28.2	36.9-40.1	31.6-33.7
45	34.84(3.84)	32.74(1.07)	33.55(0.77)
	30.5-37.9	31.8-33.9	32.7-34.2
		Murrayana	
40	30.08(3.89)	38.32(5.26)	35.72(5.73)
	25.8-33.3	33.2-43.7	29.3-40.4
42.5	29.39(2.41)	30.54(0.92)	29.01(2.36)
	26.7-31.3	29.8-31.6	27.6-31.7
45	36.65(6.43)	27.85(5.03)	26.87(3.15)
	31.8-43.9	23.1-33.1	24.1-30.3

RADIAL LUMEN DIAMETER

LAT	76 mm dbh	152 mm dbh	228 mm dbh
		Latifolia	
40	25.08(4.75)	27.99(1.91)	28.6(2.33)
	20.2-29.7	25.9-29.6	26.3-30.96
42.5	24.75(1.88)	35.07(1.43)	30.01(0.77)
	22.6-26.1	33.9-36.6	29.1-30.5
45	31.19(3.54)	29.75(0.80)	30.22(0.81)
	27.1-33.7	29.1-30.7	29.4-31.0
		Murrayana	
40	26.98(3.49)	35.48(4.69)	32.85(5.3)
	23.1-29.9	31.2-40.5	26.9-37.1
42.5	27.14(2.32)	27.26(0.58)	25.99(2.21)
	24.6-29.2	26.6-27.8	24.2-28.5
45	33.74(5.2)	24.8(4.75)	23.93(2.8)
	29.6-39.6	20.6-29.96	21.8-27.1

TREE-AVERAGE ANALYSIS FOR LATIFOLIA AND MURRAYANA/STEMWOOD

This section presents results from the correlation analysis with latewood and earlywood mixed together as in pulping. Significant correlations for each of the 11 variables are given (the p-value is in parentheses). All tests were done at the 5% level. Latifolia has n=243 and Murrayana has n=36.

1. fiber length

Latifolia : longitude zone r = .14 (.029)
stem crook(mm) r = .15 (.021)
number of live branches r = .15 (.016)
live branch angle(deg) r = -.14 (.025)
number of dead branches r = .18 (.006)

central root bark thickness(mm) r = .15 (.016)
ave ring width at 6-inch stump(mm) r = .14 (.030)

live/dead branches with no foliage as fraction of complete-tree ovendry weight r = .14 (.031)

tree-average percent compression wood in stem r = -.15 (.024)

Murrayana : lateral rootwood moisture content(pct) r = .35 (.035)

2. microfibril angle

Latifolia : latitude(deg) r = .50 (.0001)
longitude(deg) r = .41 (.0001)
elevation(m) r = -.41 (.0001)
live crown length(m) r = -.17 (.007)
number of live branches r = -.13 (.041)
number of dead branches r = .13 (.044)

crown ratio r = -.20 (.002)
stemwood specific gravity r = .15 (.022)
stembark specific gravity r = .15 (.023)
stemwood moisture content(pct) r = -.26 (.0001)
stembark moisture content(pct) r = -.19 (.003)
sapwood moisture content(pct) r = -.18 (.006)
stumpwood moisture content(pct) r = -.25 (.0001)

lateral rootwood moisture content(pct) r = -.20 (.002)

taproot moisture content(pct) r = -.20 (.002)

foliage as fraction of complete-tree ovendry weight r = -.13 (.037)

tree-average e/r1 for stemwood r = .21 (.001)

Murrayana : latitude(deg) r = .42 (.012)
longitude(deg) r = .66 (.0001)
elevation(m) r = -.69 (.0001)
stembark specific gravity r = .37 (.026)

3. latewood percentage

Latifolia : latitude(deg) r = -.40 (.0001)
longitude(deg) r = -.39 (.0001)
elevation(m) r = .30 (.0001)
taproot length(m) r = .15 (.021)
live branch angle(deg) r = -.15 (.020)

ovendry sapwood weight(g) r = .13 (.036)
stemwood moisture content(pct) r = .15 (.022)
stumpwood moisture content(pct) r = .16 (.015)

stem with bark as fraction of complete-tree ovendry weight r = .15 (.022)

live/dead branches with no foliage as fraction of complete-tree ovendry weight r = -.17 (.007)

Murrayana : longitude(deg) r = .38 (.023)
lateral root bark thickness(mm) r = -.36 (.031)
stump bark thickness(mm) r = -.40 (.015)
stemwood specific gravity r = .37 (.025)

4. resin canal number

Latifolia : latitude(deg) r = .14 (.027)
elevation(m) r = -.17 (.008)

Murrayana : longitude(deg) r = -.35 (.037)
elevation(m) r = .37 (.029)

5. resin canal diameter

Latifolia : latitude(deg) r = -.13 (.049)
tree age at 6-inch stump(yrs) r = -.14 (.028)
central root bark thickness(mm) r = -.17 (.008)

Murrayana : latitude(deg) r = .53 (.001)
longitude(deg) r = .44 (.007)
lateral root bark thickness(mm) r = -.39 (.020)

6. tangential cell diameter

Latifolia : latitude(deg) r = -.14 (.029)
elevation(m) r = .16 (.015)

stem taper inside bark from 6-inch stump to base of live crown(mm/m) r = .14 (.026)

crown ratio r = .13 (.043)
stemwood moisture content(pct) r = .16 (.013)
sapwood moisture content(pct) r = .18 (.006)

Murrayana : latitude(deg) r = -.35 (.037)
tree age at 6-inch stump(yrs) r = -.37 (.025)
live crown width(m) r = .35 (.037)

7. tangential lumen diameter

Latifolia : stem taper inside bark from 6-inch stump to base of live crown(mm/m) r = .13 (.047)

sapwood moisture content(pct) r = .15 (.023)

Murrayana : tree age at 6-inch stump(yrs) r = -.35 (.039)
live crown width(m) r = .36 (.031)

8. radial [illegible] wall thickness

Latifolia : latitude(deg) r = -.23 (.0003)
longitude(deg) r = -.19 (.003)
elevation(m) r = .19 (.002)
number of dead branches r = -.13 (.039)
stemwood specific gravity r = -.19 (.003)
stembark specific gravity r = -.16 (.011)

stemwood moisture content(pct) r = .16 (.012)
sapwood moisture content(pct) r = .14 (.025)
stumpwood moisture content(pct) r = .21 (.001)

lateral rootwood moisture content(pct) r = .20 (.001)

tap root moisture content(pct) r = .21 (.001)

Murrayana : latitude(deg) r = -.37 (.029)

9. radial cell diameter

Latifolia : latitude(deg) r = -.18 (.005)
longitude(deg) r = -.14 (.035)
elevation(m) r = .19 (.003)

stem taper inside bark from 6-inch stump to base of live crown(mm/m) r = .19 (.002)

crown ratio r = .15 (.019)
stemwood moisture content(pct) r = .19 (.004)
sapwood moisture content(pct) r = .20 (.002)

Murrayana : latitude(deg) r = -.50 (.002)

tree-average percent compression wood in stem r = .33 (.047)

10. radial lumen diameter

Latifolia : latitude(deg) r = -.14 (.033)
elevation(m) r = .15 (.018)

stem taper inside bark from 6-inch stump to base of live crown(mm/m) r = .19 (.003)

crown ratio r = .15 (.023)
stemwood moisture content(pct) r = .16 (.011)
sapwood moisture content(pct) r = .18 (.004)

Murrayana : latitude(deg) r = -.49 (.002)
live crown width(m) r = .34 (.042)

10. radial lumen diameter(cont.)

Murrayana : tree-average percent compression wood in stem
r = .34 (.045)

11. tang. wall thickness

Latifolia : latitude(deg) r = -.28 (.0001)
longitude(deg) r = -.26 (.0001)
elevation(m) r = .23 (.0004)
heartwood diam at 6-inch stump(mm) r = -.14 (.025)
stemwood specific gravity r = -.14 (.032)

stembark specific gravity r = -.16 (.014)
stemwood moisture content(pct) r = .14 (.024)
stumpwood moisture content(pct) r = .23 (.0003)
lateral rootwood moisture content(pct) r = .23 (.0003)
taproot moisture content(pct) r = .21 (.001)

Murrayana : there were no significant correlations

TREE-AVERAGE ANALYSIS FOR LATIFOLIA AND MURRAYANA/STUMP

This section presents results from the correlation analysis with latewood and earlywood mixed together as in pulping. Significant correlations for each of the 11 variables are given (the p-value is in parentheses). All tests were done at the 5% level. Latifolia has n=243 and Murrayana has n=36.

1. fiber length

Latifolia : latitude(deg) r = -.23 (.0003)
longitude(deg) r = -.19 (.003)
elevation(m) r = .24 (.0002)
stem crook(mm) r = .21 (.001)
live branch angle(deg) r = -.14 (.024)
ovendry heartwood weight(g) r = -.16 (.013)

Murrayana : there were no significant correlations

2. microfibril angle

Latifolia : latitude(deg) r = -.40 (.0001)
longitude(deg) r = -.41 (.0001)
longitude zone r = -.17 (.006)
elevation(m) r = .41 (.0001)
stemwood specific gravity r = -.14 (.031)

stemwood moisture content(pct) r = .17 (.008)
sapwood moisture content(pct) r = .13 (.041)
stumpwood moisture content(pct) r = .24 (.0002)

lateral rootwood moisture content(pct)
r = .23 (.0003)

taproot moisture content(pct) r = .18 (.004)

Murrayana : there were no significant correlations

3. latewood percentage

Latifolia : longitude(deg) r = -.15 (.017)

Murrayana : number of dead branches r = .37 (.025)
crown ratio r = -.39 (.019)
taproot moisture content(pct) r = -.35 (.034)

4. resin canal number

Latifolia : there were no significant correlations

Murrayana : taproot length(m) r = -.35 (.037)

stem taper inside bark from 6-inch stump to base
of live crown(mm/m) r = -.35 (.039)

5. resin canal diameter

Latifolia : live crown length(m) r = -.13 (.041)
stembark thickness at 6-inch stump(mm)
r = -.13 (.037)
central root bark thickness(mm) r = -.18 (.006)
stump bark thickness(mm) r = -.15 (.016)

foliage as fraction of complete-tree ovendry
weight r = -.15 (.021)

Murrayana : latitude(deg) r = .34 (.041)
lateral root bark thickness(mm) r = -.36 (.033)

6. tangential cell diameter

Latifolia : tree-average percent compression wood in stem
r = .15 (.016)

Murrayana : tree-average percent compression wood in stem
r = .43 (.008)

7. tangential lumen diameter

Latifolia : tree-average percent compression wood in stem
r = .17 (.009)

Murrayana : tree-average percent compression wood in stem
r = .42 (.010)

8. radial wall thickness

Latifolia : tree-average e/r1 for stemwood r = -.13 (.049)

Murrayana : live crown length(m) r = -.37 (.028)
crown ratio r = -.37 (.026)

9. radial cell diameter

Latifolia : dbh(mm) r = .17 (.009)
heartwood diam at 6-inch stump(mm) r = .17 (.008)
live crown width(m) r = .13 (.040)
number of live branches r = .21 (.001)
stem taper inside bark from 6-inch stump to base
of live crown(mm/m) r = .15 (.019)

ovendry stemwood weight(g) r = .16 (.011)
ovendry sapwood weight(g) r = .13 (.044)
ovendry heartwood weight(g) r = .18 (.004)

complete-tree ovendry weight(g) r = .16 (.011)
tree-average percent compression wood in stem
r = .14 (.033)

Murrayana : tree-average percent compression wood in stem
r = .38 (.021)

10. radial lumen diameter

Latifolia : dbh(mm) r = .17 (.009)
heartwood diam at 6-inch stump(mm) r = .18 (.006)
live crown width(m) r = .13 (.041)
number of live branches r = .22 (.001)

stem taper inside bark from 6-inch stump to base of live crown(mm/m) r = .16 (.013)
ovendry stemwood weight(g) r = .16 (.013)
ovendry heartwood weight(g) r = .18 (.005)
complete-tree ovendry weight(g) r = .16 (.011)

lateral rootwood moisture content(pct) r = -.13 (.039)
tree-average percent compression wood in stem r = .15 (.016)
tree-average e/r1 for stemwood r = .13 (.040)

Murrayana : tree-average percent compression wood in stem r = .38 (.022)

11. tang. wall thickness

Latifolia : latitude(deg) r = -.17 (.006)
longitude(deg) r = -.19 (.003)
stembark moisture content(pct) r = .13 (.038)
tree-average e/r1 for stemwood r = -.20 (.002)

Murrayana : there were no significant correlations

TREE-AVERAGE ANALYSIS FOR LATIFOLIA AND MURRAYANA/TAP ROOT

This section presents results from the correlation analysis with latewood and earlywood mixed together as in pulping. Significant correlations for each of the 11 variables are given (the p-value is in parentheses). All tests were done at the 5% level. Latifolia has n=243 and Murrayana has n=36.

1. fiber length

   Latifolia : elevation(m) r = .15 (.023)
   stem crook(mm) r = .20 (.002)
   stembark thickness at 6-inch stump(mm) r = -.14 (.031)

   Murrayana : there were no significant correlations

2. microfibril angle

   Latifolia : latitude(deg) r = -.23 (.0004)
   longitude(deg) r = -.24 (.0002)
   elevation(m) r = .21 (.001)

   Murrayana : there were no significant correlations

3. latewood percentage

   Latifolia : latitude(deg) r = -.19 (.003)
   longitude(deg) r = -.15 (.018)
   elevation(m) r = .18 (.006)
   heartwood diam at 6-inch stump(mm) r = -.17 (.007)
   number of dead branches r = -.17 (.009)

   ovendry heartwood weight(g) r = -.13 (.036)
   stembark specific gravity r = -.17 (.008)
   stemwood moisture content(pct) r = .18 (.004)
   stembark moisture content(pct) r = .22 (.001)
   sapwood moisture content(pct) r = .14 (.025)

   stumpwood moisture content(pct) r = .13 (.039)
   lateral rootwood moisture content(pct) r = .17 (.010)
   taproot moisture content(pct) r = .23 (.0004)

   Murrayana : stem crook(mm) r = -.36 (.029)
   number of dead branches r = .35 (.034)

4. resin canal number

   Latifolia : tree age at 6-inch stump(yrs) r = .15 (.021)
   lateral root bark thickness(mm) r = .16 (.013)
   stembark specific gravity r = .14 (.024)
   stumpwood moisture content(pct) r = -.15 (.024)
   lateral rootwood moisture content(pct) r = -.19 (.004)
   taproot moisture content(pct) r = -.19 (.004)

   tree-average percent compression wood in stem r = .13 (.037)
   tree-average e/rl for stemwood r = .24 (.0002)

4. resin canal number(cont.)

Murrayana : there were no significant correlations

5. resin canal diameter

Latifolia : stem with bark as fraction of complete-tree ovendry weight r = .14 (.028)

foliage as fraction of complete-tree ovendry weight r = -.20 (.001)

Murrayana : latitude(deg) r = .49 (.002)
longitude(deg) r = .57 (.0003)
elevation(m) r = -.41 (.014)

6. tangential cell diameter

Latifolia : there were no significant correlations

Murrayana : tree age at 6-inch stump(yrs) r = -.35 (.038)
tree-average percent compression wood in stem r = .41 (.012)

7. tangential lumen diameter

Latifolia : live branch angle(deg) r = .13 (.046)

Murrayana : tree age at 6-inch stump(yrs) r = -.35 (.035)

cones on first lineal ft of top 25 branches r = -.35 (.039)

tree-average percent compression wood in stem r = .42 (.011)

8. radial wall thickness

Latifolia : stembark thickness at 6-inch stump(mm) r = .17 (.009)
central root bark thickness(mm) r = .15 (.019)
stump bark thickness(mm) r = .14 (.026)
ave ring width at 6-inch stump(mm) r = .13 (.041)
sapwood moisture content(pct) r = .13 (.042)
taproot moisture content(pct) r = .14 (.024)

Murrayana : there were no significant correlations

9. radial cell diameter

Latifolia : dbh(mm) r = .14 (.028)
heartwood diam at 6-inch stump(mm) r = .13 (.041)
tree height to apical tip(m) r = .13 (.045)
live crown width(m) r = .14 (.025)
number of live branches r = .19 (.004)
number of dead branches r = .15 (.021)

9. radial cell diameter(cont.)

stembark thickness at 6-inch stump(mm)
r = .21 (.001)
stump bark thickness(mm) r = .17 (.009)
ovendry stemwood weight(g) r = .16 (.01)
ovendry sapwood weight(g) r = .16 (.013)
ovendry heartwood weight(g) r = .14 (.026)
complete-tree ovendry weight(g) r = .16 (.012)

Murrayana : tree-average percent compression wood in stem
r = .44 (.008)

10. radial lumen diameter

Latifolia : dbh(mm) r = .14 (.033)
heartwood diam at 6-inch stump(mm) r = .14 (.032)
tree height to apical tip(m) r = .13 (.039)
live crown width(m) r = .14 (.029)
number of live branches r = .18 (.005)
number of dead branches r = .15 (.016)

stembark thickness(mm) r = .19 (.003)
stump bark thickness(mm) r = .15 (.018)
ovendry stemwood weight(g) r = .16 (.01)
ovendry sapwood weight(g) r = .16 (.014)
ovendry heartwood weight(g) r = .14 (.024)
complete-tree ovendry weight(g) r = .16 (.012)

Murrayana : tree-average percent compression wood in stem
r = .45 (.006)

11. tang. wall thickness

Latifolia : stemwood moisture content(pct) r = .14 (.030)
sapwood moisture content(pct) r = .13 (.046)
stumpwood moisture content(pct) r = .14 (.029)
lateral rootwood moisture content(pct)
r = .15 (.019)
taproot moisture content(pct) r = .19 (.003)

Murrayana : crown ratio r = -.35 (.036)

TREE-AVERAGE ANALYSIS FOR LATIFOLIA AND MURRAYANA/LATERAL ROOT

This section presents results from the correlation analysis with latewood and earlywood mixed together as in pulping. Significant correlations for each of the 11 variables are given (the p-value is in parentheses). All tests were done at the 5% level. Latifolia has n=243 and Murrayana has n=36.

1. fiber length

   Latifolia : stemwood specific gravity r = -.15 (.019)

   Murrayana : longitude(deg) r = .33 (.047)

2. microfibril angle

   Latifolia : latitude(deg) r = -.27 (.0001)
   longitude(deg) r = -.26 (.0001)
   elevation(m) r = .25 (.0001)
   stembark specific gravity r = -.16 (.014)
   stemwood moisture content(pct) r = .16 (.015)
   stembark moisture content(pct) r = .19 (.003)
   stumpwood moisture content(pct) r = .17 (.010)
   lateral rootwood moisture content(pct) r = .16 (.011)

   Murrayana : live crown length(m) r = -.37 (.028)
   central root bark thickness(mm) r = -.36 (.030)

3. latewood percentage

   Latifolia : latitude(deg) r = -.22 (.001)
   longitude(deg) r = -.20 (.002)
   elevation(m) r = .17 (.008)
   stemwood specific gravity r = -.14 (.032)
   stemwood moisture content(pct) r = .22 (.001)

   stembark moisture content(pct) r = .15 (.016)
   sapwood moisture content(pct) r = .20 (.002)
   stumpwood moisture content(pct) r = .14 (.028)
   lateral rootwood moisture content(pct) r = .17 (.009)
   taproot moisture content(pct) r = .23 (.0004)

   foliage as fraction of complete-tree ovendry weight r = .14 (.032)

   Murrayana : there were no significant correlations

4. resin canal number

   Latifolia : tree age at 6-inch stump(yrs) r = .14 (.031)
   tree-average percent compression wood in stem r = .15 (.022)

   Murrayana : there were no significant correlations

5. resin canal diameter

Latifolia : central root bark thickness(mm) r = -.18 (.006)
lateral root bark thickness(mm) r = -.14 (.030)
stemwood specific gravity r = .14 (.029)

Murrayana : central root bark thickness(mm) r = -.41 (.013)

6. tangential cell diameter

Latifolia : latitude(deg) r = .15 (.023)
longitude(deg) r = .19 (.004)
longitude zone r = .14 (.025)
taproot length(m) r = -.15 (.024)
live branch angle(deg) r = .21 (.001)

stumpwood moisture content(pct) r = -.16 (.010)
lateral rootwood moisture content(pct) r = -.21 (.001)
taproot moisture content(pct) r = -.15 (.019)
stump-root system as fraction of complete-tree ovendry weight r = .15 (.016)

Murrayana : tree-average percent compression wood in stem
r = .40 (.017)

7. tangential lumen diameter

Latifolia : latitude(deg) r = .14 (.024)
longitude(deg) r = .19 (.004)
longitude zone r = .14 (.024)
taproot length(m) r = -.14 (.031)
live branch angle(deg) r = .21 (.001)

stemwood specific gravity r = .13 (.042)
stumpwood moisture content(pct) r = -.17 (.009)
lateral rootwood moisture content(pct) r = -.22 (.001)
taproot moisture content(pct) r = -.17 (.009)
stump-root system as fraction of complete-tree ovendry weight r = .15 (.022)

Murrayana : tree-average percent compression wood in stem
r = .38 (.021)

8. radial wall thickness

Latifolia : tree-average e/rl for stemwood r = -.13 (.045)

Murrayana : live crown width(m) r = .36 (.030)

9. radial cell diameter

Latifolia : lateral rootwood moisture content(pct) r = .14 (.035)

Murrayana : tree-average percent compression wood in stem
r = .38 (.021)

10. radial lumen diameter

Latifolia : live branch angle(deg) r = .13 (.037)
lateral rootwood moisture content(pct) r = -.14 (.026)
taproot moisture content(pct) r = -.13 (.045)

Murrayana : tree-average percent compression wood in stem
r = .40 (.016)

11. tang. wall thickness

Latifolia : taproot moisture content(pct) r = .15 (.022)

Murrayana : foliage as fraction of complete-tree ovendry
weight r = -.38 (.021)

TREE-AVERAGE VALUES COMPARED --- LATIFOLIA VS. MURRAYANA
with latewood and earlywood combined as in pulping, the means for the two varieties were compared using either the t-test or approximate t-test (when variances were unequal); n=243 for Latifolia and n=36 for Murrayana; means are given with standard deviations in parentheses

1. fiber length (mm)

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	2.20(0.54)	2.81(0.40)	.0001	x
stump	2.47(0.37)	2.61(0.46)	.1000	
tap root	2.15(0.38)	2.39(0.39)	.0004	x
lateral root	1.96(0.35)	2.17(0.45)	.0100	x

2. microfibril angle (degrees)

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	26.83(6.15)	25.34(4.36)	.0780	
stump	30.47(4.11)	32.54(4.90)	.0060	x
tap root	32.37(4.45)	33.33(4.20)	.2260	
lateral root	34.09(4.52)	34.71(3.84)	.4310	

3. latewood percentage

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	14.77(2.64)	17.15(2.88)	.0001	x
stump	12.61(3.32)	13.14(3.20)	.3700	
tap root	10.18(2.32)	12.78(3.10)	.0001	x
lateral root	9.66(2.28)	11.64(3.03)	.0005	x

4. resin canal number

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	37.30(5.63)	35.27(6.69)	.0510	
stump	38.52(9.14)	35.19(6.16)	.0070	x
tap root	39.09(9.45)	34.25(7.28)	.0010	x
lateral root	37.85(8.82)	33.14(7.24)	.0030	x

5. resin canal diameter

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	71.91(4.94)	73.29(5.84)	.1300	
stump	72.71(6.38)	73.67(7.39)	.4130	
tap root	72.24(6.33)	72.97(5.87)	.5130	
lateral root	70.67(6.45)	73.03(5.23)	.0370	x

6. tangential cell diameter

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	33.31(3.16)	32.55(3.91)	.2700	
stump	32.58(4.07)	32.45(5.48)	.8900	
tap root	32.11(4.05)	31.06(5.27)	.2590	
lateral root	31.79(4.13)	30.38(4.49)	.0600	

7. tangential lumen diameter

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	27.86(3.20)	27.53(3.77)	.5740	
stump	27.76(4.08)	28.12(5.41)	.7040	
tap root	27.92(4.05)	26.96(5.42)	.3140	
lateral root	27.78(4.18)	26.52(4.42)	.0940	

8. radial wall thickness

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	2.73(0.33)	2.51(0.30)	.0003	x
stump	2.41(0.48)	2.15(0.43)	.0020	x
tap root	2.09(0.39)	2.04(0.41)	.4140	
lateral root	2.00(0.38)	1.93(0.32)	.2780	

9. radial cell diameter

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	33.87(3.33)	32.49(4.36)	.0750	
stump	33.37(4.13)	33.22(6.37)	.8900	
tap root	33.15(4.51)	31.75(5.85)	.1750	
lateral root	32.86(4.48)	31.21(4.87)	.0430	x

10. radial lumen diameter

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	29.74(3.36)	28.58(4.27)	.1270	
stump	29.79(4.21)	30.02(6.19)	.8280	
tap root	30.04(4.63)	28.60(6.05)	.1770	
lateral root	29.93(4.52)	28.37(4.65)	.0550	

11. tang. wall thickness

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	2.07(0.27)	1.96(0.30)	.0360	x
stump	1.79(0.40)	1.60(0.37)	.0072	x
tap root	1.56(0.39)	1.58(0.40)	.7750	
lateral root	1.46(0.34)	1.42(0.30)	.4670	

TREE-AVERAGE CORRELATIONS

with latewood and earlywood combined as in pulping, some correlations were computed; only correlations significant at the 5% level are reported here; the correlation is given with the p-value in parentheses

1. fiber length with microfibril angle

Latifolia :	stemwood	-- r = -.15 (p = .019)
	stump	-- r = -.341 (p = .0001)
	tap root	-- r = -.493 (p = .0001)
	lateral root	-- r = -.575 (p = .0001)
Murrayana :	stump	-- r = -.33 (p = .049)
	tap root	-- r = -.407 (p = .014)
	lateral root	-- r = -.335 (p = .046)

2. latewood percentage with resin canal number

Murrayana : lateral root -- r = -.368 (p = .027)

3. growth ring width(mm/yr) with microfibril angle

Latifolia : stemwood -- r = -.14 (.025)

4. growth ring width with tangential cell diameter

Latifolia : lateral root -- r = -.16 (.011)

5. growth ring width with tangential lumen diameter

Latifolia : lateral root -- r = -.18 (.006)

PHASE 2: TREE-AVERAGE ANALYSIS
EARLYWOOD AND LATEWOOD SEPARATED

Tree average wood and cell property values for both the earlywood and latewood for var. murrayana, and var. latifolia are reported in this section. Results are summarized in the listing of ANOVA results.

TREE-AVERAGE ANALYSIS FOR LATIFOLIA/STEMWOOD

This section presents the results from analysis of variance for the 8 variables separated into earlywood/latewood. Thus, results are presented for 16 variables. No further summary tables are presented. All tests were done at the 5% level.

1. EARLYWOOD FIBER LENGTH

   the LxExD, ExD, LxD and LxE interactions were significant

2. LATEWOOD FIBER LENGTH

   the LxExD, ExD, LxD and LxE interactions were significant

3. EARLYWOOD MICROFIBRIL ANGLE

   the LxExD, ExD and LxE interactions were significant

4. LATEWOOD MICROFIBRIL ANGLE

   the LxExD and LxE interactions were significant

5. EARLYWOOD TANGENTIAL CELL DIAMETER

   the latitude means were significantly different

6. LATEWOOD TANGENTIAL CELL DIAMETER

   the latitude means were significantly different

7. EARLYWOOD TANGENTIAL LUMEN DIAMETER

   the latitude means were significantly different

8. LATEWOOD TANGENTIAL LUMEN DIAMETER

   the LxExD interaction was significant

9. EARLYWOOD RADIAL WALL THICKNESS

   the LxExD and LxD interactions were significant

10. LATEWOOD RADIAL WALL THICKNESS

    the LxExD interaction was significant

11. EARLYWOOD RADIAL CELL DIAMETER

    the latitude means were significantly different

12. LATEWOOD RADIAL CELL DIAMETER

    the latitude means were significantly different

13. EARLYWOOD RADIAL LUMEN DIAMETER

    the latitude means were significantly different

14. LATEWOOD RADIAL LUMEN DIAMETER

---

the latitude means were significantly different

15. EARLYWOOD TANG. WALL THICKNESS

---

the latitude means were significantly different

16. LATEWOOD TANG. WALL THICKNESS

---

the latitude means were significantly different

TREE-AVERAGE ANALYSIS FOR LATIFOLIA/STUMP

This section presents the results from analysis of variance for the 8 variables separated into earlywood/latewood. Thus, results are presented for 16 variables. No further summary tables are presented. All tests were done at the 5% level.

1. EARLYWOOD FIBER LENGTH

   the latitude means were significantly different

2. LATEWOOD FIBER LENGTH

   the LxExD interaction was significant

3. EARLYWOOD MICROFIBRIL ANGLE

   the latitude means were significantly different

4. LATEWOOD MICROFIBRIL ANGLE

   the LxD interaction was significant

5. EARLYWOOD TANGENTIAL CELL DIAMETER

   there were no significant differences

6. LATEWOOD TANGENTIAL CELL DIAMETER

   the latitude means were significantly different

7. EARLYWOOD TANGENTIAL LUMEN DIAMETER

   there were no significnat differences

8. LATEWOOD TANGENTIAL LUMEN DIAMETER

   the latitude means were significantly different

9. EARLYWOOD RADIAL WALL THICKNESS

   there were no significant differences

10. LATEWOOD RADIAL WALL THICKNESS

    the latitude means were significantly different

11. EARLYWOOD RADIAL CELL DIAMETER

    the diameter means were significantly different

12. LATEWOOD RADIAL CELL DIAMETER

    the latitude means were significantly different

13. EARLYWOOD RADIAL LUMEN DIAMETER

    the LxD interaction was significant

14. LATEWOOD RADIAL LUMEN DIAMETER

---

the latitude means were significantly different

15. EARLYWOOD TANG. WALL THICKNESS

---

the latitude means were significantly different

16. LATEWOOD TANG. WALL THICKNESS

---

the LxE interaction was significant

TREE-AVERAGE ANALYSIS FOR LATIFOLIA/TAP ROOT

This section presents the results from analysis of variance for the 8 variables separated into earlywood/latewood. Thus, results are presented for 16 variables. No further summary tables are presented. All tests were done at the 5% level.

1. EARLYWOOD FIBER LENGTH

   the latitude means were significantly different and the ExD interaction was significant

2. LATEWOOD FIBER LENGTH

   the latitude means were significantly different

3. EARLYWOOD MICROFIBRIL ANGLE

   the latitude means were significantly different and the ExD interaction was significant

4. LATEWOOD MICROFIBRIL ANGLE

   the latitude means were significantly different and the ExD interaction was significant

5. EARLYWOOD TANGENTIAL CELL DIAMETER

   the latitude means were significantly different

6. LATEWOOD TANGENTIAL CELL DIAMETER

   the latitude means were significantly different

7. EARLYWOOD TANGENTIAL LUMEN DIAMETER

   the latitude means were significantly different

8. LATEWOOD TANGENTIAL LUMEN DIAMETER

   the LxExD and LxE interactions were significant

9. EARLYWOOD RADIAL [illegible] WALL THICKNESS

   the LxE interaction was significant

10. LATEWOOD RADIAL [illegible] WALL THICKNESS

    the LxE interaction was significant

11. EARLYWOOD RADIAL CELL DIAMETER

    the LxExD, ExD and LxE interactions were significant

12. LATEWOOD RADIAL CELL DIAMETER

    the latitude means were significantly different

13. EARLYWOOD RADIAL LUMEN DIAMETER

---

the LxExD, ExD and LxE interactions were significant

14. LATEWOOD RADIAL LUMEN DIAMETER

---

the latitude means were significantly different

15. EARLYWOOD TANG. WALL THICKNESS

---

the LxExD, LxD and LxE interactions were significant

16. LATEWOOD TANG. WALL THICKNESS

---

the diameter means were significantly different and the LxE interaction was significant

TREE-AVERAGE ANALYSIS FOR LATIFOLIA/LATERAL ROOT

This section presents the results from analysis of variance for the 8 variables separated into earlywood/latewood. Thus, results are presented for 16 variables. No further summary tables are presented. All tests were done at the 5% level.

1. EARLYWOOD FIBER LENGTH

   the LxE interaction was significant

2. LATEWOOD FIBER LENGTH

   the latitude means were significantly different

3. EARLYWOOD MICROFIBRIL ANGLE

   the latitude means were significantly different

4. LATEWOOD MICROFIBRIL ANGLE

   the latitude means were significantly different

5. EARLYWOOD TANGENTIAL CELL DIAMETER

   the latitude means were significantly different

6. LATEWOOD TANGENTIAL CELL DIAMETER

   the LxExD and LxE interactions were significant

7. EARLYWOOD TANGENTIAL LUMEN DIAMETER

   the latitude means were significantly different

8. LATEWOOD TANGENTIAL LUMEN DIAMETER

   the LxExD interaction was significant

9. EARLYWOOD RADIAL WALL THICKNESS

   there were no significant differences

10. LATEWOOD RADIAL WALL THICKNESS

    the LxExD interaction was significant

11. EARLYWOOD RADIAL CELL DIAMETER

    the LxExD and LxE interactions were significant

12. LATEWOOD RADIAL CELL DIAMETER

    the latitude means were significantly different and the ExD interaction was significant

13. EARLYWOOD RADIAL LUMEN DIAMETER

---

the LxExD and LxE interactions were significant

14. LATEWOOD RADIAL LUMEN DIAMETER

---

the latitude means were significantly different and the ExD interaction was significant

15. EARLYWOOD TANG. WALL THICKNESS

---

the latitude means were significantly different

16. LATEWOOD TANG. WALL THICKNESS

---

the LxExD interaction was significant

TREE-AVERAGE ANALYSIS FOR MURRAYANA/STEMWOOD

This section presents the results from analysis of variance for the 8 variables separated into earlywood/latewood. Thus, results are presented for 16 variables. No further summary tables are presented. All tests were done at the 5% level.

1. EARLYWOOD FIBER LENGTH

   there were no significant differences

2. LATEWOOD FIBER LENGTH

   there were no significant differences

3. EARLYWOOD MICROFIBRIL ANGLE

   the latitude means were significantly different

4. LATEWOOD MICROFIBRIL ANGLE

   the latitude means were significantly different

5. EARLYWOOD TANGENTIAL CELL DIAMETER

   the latitude means were significantly different

6. LATEWOOD TANGENTIAL CELL DIAMETER

   there were no significant differences

7. EARLYWOOD TANGENTIAL LUMEN DIAMETER

   the latitude means were significantly different

8. LATEWOOD TANGENTIAL LUMEN DIAMETER

   there were no significant differences

9. EARLYWOOD RADIAL CELL WALL THICKNESS

   the latitude means were significantly different

10. LATEWOOD RADIAL CELL WALL THICKNESS

    the LxD interaction was significant

11. EARLYWOOD RADIAL CELL DIAMETER

    the latitude means were significantly different

12. LATEWOOD RADIAL CELL DIAMETER

    the latitude means were significantly different

13. EARLYWOOD RADIAL LUMEN DIAMETER

---

the latitude means were significantly different

14. LATEWOOD RADIAL LUMEN DIAMETER

---

the latitude means were significantly different

15. EARLYWOOD TANG. WALL THICKNESS

---

the LxD interaction was significant

16. LATEWOOD TANG. WALL THICKNESS

---

the LxD interaction was significant

TREE-AVERAGE ANALYSIS FOR MURRAYANA/STUMP

This section presents the results from analysis of variance for the 8 variables separated into earlywood/latewood. Thus, results are presented for 16 variables. No further summary tables are presented. All tests were done at the 5% level.

1. EARLYWOOD FIBER LENGTH

   the LxD interaction was significant

2. LATEWOOD FIBER LENGTH

   there were no significant differences

3. EARLYWOOD MICROFIBRIL ANGLE

   there were no significant differences

4. LATEWOOD MICROFIBRIL ANGLE

   there were no significant differences

5. EARLYWOOD TANGENTIAL CELL DIAMETER

   the LxD interaction was significant

6. LATEWOOD TANGENTIAL CELL DIAMETER

   the LxD interaction was significant

7. EARLYWOOD TANGENTIAL LUMEN DIAMETER

   the LxD interaction was significant

8. LATEWOOD TANGENTIAL LUMEN DIAMETER

   the LxD interaction was significant

9. EARLYWOOD RADIAL WALL THICKNESS

   the LxD interaction was significant

10. LATEWOOD RADIAL WALL THICKNESS

    there were no significant differences

11. EARLYWOOD RADIAL CELL DIAMETER

    the LxD interaction was significant

12. LATEWOOD RADIAL CELL DIAMETER

    the LxD interaction was significant

13. EARLYWOOD RADIAL LUMEN DIAMETER

the LxD interaction was significant

14. LATEWOOD RADIAL LUMEN DIAMETER

the LxD interaction was significant

15. EARLYWOOD TANG. WALL THICKNESS

there were no significant differences

16. LATEWOOD TANG. WALL THICKNESS

the LxD interaction was significant

TREE-AVERAGE ANALYSIS FOR MURRAYANA/TAP ROOT

This section presents the results from analysis of variance for the 8 variables separated into earlywood/latewood. Thus, results are presented for 16 variables. No further summary tables are presented. All tests were done at the 5% level.

1. EARLYWOOD FIBER LENGTH

   there were no significant differences

2. LATEWOOD FIBER LENGTH

   there were no significant differences

3. EARLYWOOD MICROFIBRIL ANGLE

   there were no significant differences

4. LATEWOOD MICROFIBRIL ANGLE

   there were no significant differences

5. EARLYWOOD TANGENTIAL CELL DIAMETER

   the LxD interaction was significant

6. LATEWOOD TANGENTIAL CELL DIAMETER

   there were no significant differences

7. EARLYWOOD TANGENTIAL LUMEN DIAMETER

   the LxD interaction was significant

8. LATEWOOD TANGENTIAL LUMEN DIAMETER

   the latitude means were significantly different

9. EARLYWOOD RADIAL WALL THICKNESS

   the diameter means were significantly different

10. LATEWOOD RADIAL WALL THICKNESS

    there were no significant differences

11. EARLYWOOD RADIAL CELL DIAMETER

    the LxD interaction was significant

12. LATEWOOD RADIAL CELL DIAMETER

    there were no significant differences

13. EARLYWOOD RADIAL LUMEN DIAMETER

---

the latitude means were significantly different

14. LATEWOOD RADIAL LUMEN DIAMETER

---

there were no significant differences

15. EARLYWOOD TANG. WALL THICKNESS

---

the LxD interaction was significant

16. LATEWOOD TANG. WALL THICKNESS

---

there were no significant differences

TREE-AVERAGE ANALYSIS FOR MURRAYANA/LATERAL ROOT

This section presents the results from analysis of variance for the 8 variables separated into earlywood/latewood. Thus, results are presented for 16 variables. No further summary tables are presented. All tests were done at the 5% level.

1. EARLYWOOD FIBER LENGTH

   there were no significant differences

2. LATEWOOD FIBER LENGTH

   there were no significant differences

3. EARLYWOOD MICROFIBRIL ANGLE

   there were no significant differences

4. LATEWOOD MICROFIBRIL ANGLE

   there were no significant differences

5. EARLYWOOD TANGENTIAL CELL DIAMETER

   the latitude means were significantly different

6. LATEWOOD TANGENTIAL CELL DIAMETER

   there were no significant differences

7. EARLYWOOD TANGENTIAL LUMEN DIAMETER

   the latitude means were significantly different

8. LATEWOOD TANGENTIAL LUMEN DIAMETER

   the latitude means were significantly different

9. EARLYWOOD RADIAL WALL THICKNESS

   there were no significant differences

10. LATEWOOD RADIAL WALL THICKNESS

    there were no significant differences

11. EARLYWOOD RADIAL CELL DIAMETER

    the LxD interaction was significant

12. LATEWOOD RADIAL CELL DIAMETER

    there were no significant differences

13. EARLYWOOD RADIAL LUMEN DIAMETER

the LxD interaction was significant

14. LATEWOOD RADIAL LUMEN DIAMETER

the LxD interaction was significant

15. EARLYWOOD TANG. WALL THICKNESS

there were no significant differences

16. LATEWOOD TANG. WALL THICKNESS

there were no significant differences

TREE-AVERAGE ANALYSIS FOR LAT VS MUR/STEMWOOD

This section presents the results from analysis of variance for the 8 variables separated into earlywood/latewood. Thus, results are presented for 16 variables. No further summary tables are presented. All tests were done at the 5% level.

1. EARLYWOOD FIBER LENGTH

   the LxD, VxD and VxL interactions were significant

2. LATEWOOD FIBER LENGTH

   the latitude means were significantly different and the VxD interaction was significant

3. EARLYWOOD MICROFIBRIL ANGLE

   the VxLxD and VxL interactions were significant

4. LATEWOOD MICROFIBRIL ANGLE

   the VxL interaction was significant

5. EARLYWOOD TANGENTIAL CELL DIAMETER

   the VxL interaction was significant

6. LATEWOOD TANGENTIAL CELL DIAMETER

   there were no significant differences

7. EARLYWOOD TANGENTIAL LUMEN DIAMETER

   there were no significant differences

8. LATEWOOD TANGENTIAL LUMEN DIAMETER

   the variety means were significantly different

9. EARLYWOOD RADIAL WALL THICKNESS

   the variety means were significantly different and the the LxD interaction was significant

10. LATEWOOD RADIAL WALL THICKNESS

    the variety means were significantly different and the LxD interaction was significant

11. EARLYWOOD RADIAL CELL DIAMETER

    the VxL interaction was significant

12. LATEWOOD RADIAL CELL DIAMETER

    there were no significant differences

13. EARLYWOOD RADIAL LUMEN DIAMETER

---

the VxL interaction was significant

14. LATEWOOD TANG. LUMEN DIAMETER

---

there were no significant differences

15. EARLYWOOD TANG. WALL THICKNESS

---

the variety means were significantly different and the LxD interaction was significant

16. LATEWOOD RADIAL WALL THICKNESS

---

the variety means were significantly different and the LxD interaction was significant

TREE-AVERAGE ANALYSIS FOR LAT VS MUR/STUMP

This section presents the results from analysis of variance for the 8 variables separated into earlywood/latewood. Thus, results are presented for 16 variables. No further summary tables are presented. All tests were done at the 5% level.

1. EARLYWOOD FIBER LENGTH

   the VxLxD interaction was significant

2. LATEWOOD FIBER LENGTH

   there were no significant differences

3. EARLYWOOD MICROFIBRIL ANGLE

   there were no significant differences

4. LATEWOOD MICROFIBRIL ANGLE

   the VxL interaction was significant

5. EARLYWOOD TANGENTIAL CELL DIAMETER

   the VxLxD interaction was significant

6. LATEWOOD TANGENTIAL CELL DIAMETER

   the VxLxD interaction was significant

7. EARLYWOOD TANGENTIAL LUMEN DIAMETER

   the VxLxD interaction was significant

8. LATEWOOD TANGENTIAL LUMEN DIAMETER

   the VxLxD interaction was significant

9. EARLYWOOD RADIAL WALL THICKNESS

   the variety means were significantly different and the the LxD interaction was significant

10. LATEWOOD RADIAL WALL THICKNESS

    the variety means were significantly different

11. EARLYWOOD RADIAL CELL DIAMETER

    the VxLxD, LxD and VxL interactions were significant

12. LATEWOOD RADIAL CELL DIAMETER

    the variety means were significantly different

13. EARLYWOOD RADIAL LUMEN DIAMETER

---

the VxLxD, LxD and VxL interactions were significant

14. LATEWOOD RADIAL LUMEN DIAMETER

---

the variety means were significantly different

15. EARLYWOOD : TANG. WALL THICKNESS

---

the variety means were significantly different

16. LATEWOOD TANG.WALL THICKNESS

---

the variety means were significantly different and the LxD interaction was significant

TREE-AVERAGE ANALYSIS FOR LAT VS MUR/TAP ROOT

This section presents the results from analysis of variance for the 8 variables separated into earlywood/latewood. Thus, results are presented for 16 variables. No further summary tables are presented. All tests were done at the 5% level.

1. EARLYWOOD FIBER LENGTH

   the variety means were significantly different

2. LATEWOOD FIBER LENGTH

   there were no significant differences

3. EARLYWOOD MICROFIBRIL ANGLE

   there were no significant differences

4. LATEWOOD MICROFIBRIL ANGLE

   there were no significant differences

5. EARLYWOOD TANGENTIAL CELL DIAMETER

   the VxLxD and VxL interactions were significant

6. LATEWOOD TANGENTIAL CELL DIAMETER

   the VxL interaction was significant

7. EARLYWOOD TANGENTIAL LUMEN DIAMETER

   the VxLxD and VxL interactions were significant

8. LATEWOOD TANGENTIAL LUMEN DIAMETER

   the VxL interaction was significant

9. EARLYWOOD RADIAL WALL THICKNESS

   the VxLxD interaction was significant

10. LATEWOOD RADIAL WALL THICKNESS

    the variety and latitude means were significantly different

11. EARLYWOOD RADIAL CELL DIAMETER

    the VxLxD, LxD and VxL interactions were significant

12. LATEWOOD RADIAL CELL DIAMETER

    there were no significant differences

13. EARLYWOOD RADIAL LUMEN DIAMETER

---

the VxLxD, LxD and VxL interactions were significant

14. LATEWOOD RADIAL LUMEN DIAMETER

---

there were no significant differences

15. EARLYWOOD TANG. WALL THICKNESS

---

the VxLxD interaction was significant

16. LATEWOOD TANG.WALL THICKNESS

---

there were no significant differences

TREE-AVERAGE ANALYSIS FOR LAT VS MUR/LATERAL ROOT

This section presents the results from analysis of variance for the 8 variables separated into earlywood/latewood. Thus, results are presented for 16 variables. No further summary tables are presented. All tests were done at the 5% level.

1. EARLYWOOD FIBER LENGTH

   the variety means were significantly different

2. LATEWOOD FIBER LENGTH

   there were no significant differences

3. EARLYWOOD MICROFIBRIL ANGLE

   there were no significant differences

4. LATEWOOD MICROFIBRIL ANGLE

   there were no significant differences

5. EARLYWOOD TANGENTIAL CELL DIAMETER

   the LxD, VxD and VxL interactions were significant

6. LATEWOOD TANGENTIAL CELL DIAMETER

   the variety means were significantly different and the LxD interaction was significant

7. EARLYWOOD TANGENTIAL LUMEN DIAMETER

   the VxLxD, LxD, VxD and VxL interactions were significant

8. LATEWOOD TANGENTIAL LUMEN DIAMETER

   the variety means were significantly different and the LxD interaction was significant

9. EARLYWOOD RADIAL WALL THICKNESS

   there were no significant differences

10. LATEWOOD RADIAL WALL THICKNESS

    the variety and latitude means were significantly different

11. EARLYWOOD RADIAL CELL DIAMETER

    the LxD and VxL interactions were significant

12. LATEWOOD RADIAL CELL DIAMETER

    the variety means were significantly different and the LxD interaction was significant

13. EARLYWOOD RADIAL LUMEN DIAMETER

the VxLxD, LxD and VxL interactions were significant

14. LATEWOOD RADIAL LUMEN DIAMETER

the variety means were significantly different and the LxD interaction was significant

15. EARLYWOOD TANG. WALL THICKNESS

there were no significant differences

16. LATEWOOD TANG.WALL THICKNESS

the LxD interaction was significant

TREE-AVERAGE ANALYSIS FOR LATIFOLIA AND MURRAYANA/STEMWOOD

This section presents results from the correlation analysis for the 8 variables separated into earlywood/latewood. Thus, results are presented for 16 variables. Significant correlations for each of the variables are given (the p-value follows in parentheses). All tests were done at the 5% level. Latifolia has n=243 and Murrayana has n=36.

1. earlywood fiber length

   Latifolia : latitude zone r = .15 (.019)
   stem crook(mm) r = .13 (.041)
   number of live branches r = .16 (.013)
   live branch angle(deg) r = -.13 (.039)
   number of dead branches r = .17 (.007)

   central root bark thickness(mm) r = .15 (.022)
   ave ring width at 6-inch stump(mm) r = .13 (.045)
   stembark specific gravity r = -.13 (.039)
   live/dead branches with no foliage as fraction of complete-tree ovendry weight r = .14 (.030)

   tree-average percent compression wood in stem r = -.14 (.031)

   Murrayana : there were no significant correlations

2. latewood fiber length

   Latifolia : stem crook(mm) r = .16 (.012)
   number of dead branches r = .17 (.007)
   central root bark thickness(mm) r = .13 (.040)
   ave ring width at 6-inch stump(mm) r = .14 (.026)

   tree-average percent compression wood in stem r = -.14 (.034)

   Murrayana : latitude(deg) r = -.45 (.006)
   elevation(m) r = .34 (.041)
   tree age at 6-inch stump(yrs) r = -.38 (.024)
   stemwood moisture content(pct) r = .35 (.039)
   stembark moisture content(pct) r = .34 (.040)
   lateral rootwood moisture content(pct) r = .45 (.006)

3. earlywood microfibril angle

   Latifolia : latitude(deg) r = .48 (.0001)
   longitude(deg) r = .39 (.0001)
   elevation(m) r = -.39 (.0001)
   live crown length r = -.18 (.005)
   crown ratio r = -.19 (.003)

   stembark specific gravity r = .14 (.031)
   stemwood moisture content(pct) r = -.23 (.0002)
   stembark moisture content(pct) r = -.19 (.004)
   sapwood moisture content(pct) r = -.15 (.018)
   stumpwood moisture content(pct) r = -.24 (.0001)

3. earlywood microfibril angle(cont.)

Latifolia : lateral rootwood moisture content(pct) r = -.18 (.004)
taproot moisture content(pct) r = -.18 (.006)
tree-average e/rl for stemwood r = .22 (.0005)

Murrayana : latitude(deg) r = .37 (.026)
longitude(deg) r = .64 (.0001)
elevation(m) r = -.67 (.0001)
stembark specific gravity r = .35 (.036)

4. latewood microfibril angle

Latifolia : latitude(deg) r = .44 (.0001)
longitude(deg) r = .36 (.0001)
elevation(m) r = -.36 (.0001)
live crown length(m) r = -.13 (.037)
number of live branches r = -.14 (.028)
live branch angle(deg) r = .15 (.023)
crown ratio r = -.14 (.029)

stemwood specific gravity r = .20 (.002)
stembark specific gravity r = .13 (.043)
stemwood moisture content(pct) r = -.22 (.001)
stembark moisture content(pct) r = -.14 (.033)
sapwood moisture content(pct) r = -.15 (.022)
stumpwood moisture content(pct) r = -.20 (.002)
lateral rootwood moisture content(pct) r = -.16 (.010)
taproot moisture content(pct) r = -.19 (.004)

tree-average e/rl for stemwood r = .15 (.018)

Murrayana : latitude(deg) r = .63 (.0001)
longitude(deg) r = .76 (.0001)
elevation(m) r = -.80 (.0001)
stemwood specific gravity r = .35 (.035)
stembark specific gravity r = .42 (.012)
stemwood moisture content(pct) r = -.36 (.029)
stembark moisture content(pct) r = -.38 (.023)
lateral rootwood moisture content(pct) r = -.34 (.042)

stem with bark as fraction of complete-tree ovendry weight r = .36 (.033)

foliage as fraction of complete-tree ovendry weight r = -.37 (.027)

5. earlywood tangential cell diameter

Latifolia : latitude(deg) r = -.15 (.021)
elevation(m) r = .16 (.015)
stemwood moisture content(pct) r = .15 (.017)
sapwood moisture content(pct) r = .16 (.011)

Murrayana : latitude(deg) r = -.35 (.034)
tree age at 6-inch stump(yrs) r = -.42 (.010)
cones on first lineal ft of top 25 branches r = -.35 (.039)
stembark moisture content(pct) r = .33 (.049)

6. latewood tangential cell diameter

Latifolia : latitude(deg) r = -.18 (.005)
longitude(deg) r = -.13 (.045)
elevation(m) r = .21 (.001)
cones on first lineal ft of top 25 branches
r = .14 (.032)
stem taper inside bark from 6-inch stump to base
of live crown(mm/m) r = .21 (.001)
crown ratio r = .13 (.041)

stemwood specific gravity r = -.17 (.008)
stemwood moisture content(pct) r = .21 (.001)
sapwood moisture content(pct) r = .25 (.0001)
lateral rootwood moisture content(pct) r = .16 (.014)

stem with bark as fraction of complete-tree
ovendry weight r = -.14 (.035)

Murrayana : live crown width(m) r = .41 (.013)
stembark thickness at 6-inch stump(mm)
r = .34 (.045)

7. earlywood tangential lumen diameter

Latifolia : elevation(m) r = .13 (.036)
stemwood moisture content(pct) r = .13 (.045)
sapwood moisture content(pct) r = .14 (.031)

Murrayana : tree age at 6-inch stump(yrs) r = -.41 (.014)
cones on first lineal ft of top 25 branches
r = -.34 (.043)

8. latewood tangential lumen diameter

Latifolia : elevation(m) r = .13 (.049)
cones on first lineal ft of top 25 branches
r = .13 (.046)
stem taper inside bark from 6-inch stump to base
of live crown(mm/m) r = .17 (.009)
stemwood moisture content(pct) r = .15 (.017)
sapwood moisture content(pct) r = .20 (.002)

Murrayana : live crown width(m) r = .38 (.024)

9. earlywood RADIAL wall thickness

Latifolia : stemwood specific gravity r = -.19 (.003)
stembark specific gravity r = -.18 (.006)
stumpwood moisture content(pct) r = .15 (.018)
lateral rootwood moisture content(pct) r = .17 (.010)
taproot moisture content(pct) r = .20 (.002)

Murrayana : latitude(deg) r = -.41 (.014)

10. latewood RADIAL wall thickness

Latifolia : latitude(deg) r = -.27 (.0001)
longitude(deg) r = -.25 (.0001)
elevation(m) r = .23 (.0003)
number of dead branches r = -.17 (.007)

10. latewood RADIAL wall thickness(cont.)

Latifolia : stemwood specific gravity r = -.17 (.009)
stemwood moisture content(pct) r = .16 (.012)
stumpwood moisture content(pct) r = .25 (.0001)
lateral rootwood moisture content(pct) r = .22 (.001)
taproot moisture content(pct) r = .23 (.0004)

Murrayana : latitude(deg) r = -.38 (.022)
longitude(deg) r = -.35 (.037)

11. earlywood radial cell diameter

Latifolia : latitude(deg) r = -.20 (.001)
longitude(deg) r = -.16 (.011)
elevation(m) r = .20 (.002)
stem taper inside bark from 6-inch stump to base of live crown(mm/m) r = .17 (.009)
crown ratio r = .15 (.022)
stemwood moisture content(pct) r = .18 (.004)
sapwood moisture content(pct) r = .19 (.003)

Murrayana : latitude(deg) r = -.49 (.002)
tree-average percent compression wood in stem r = .38 (.024)

12. latewood radial cell diameter

Latifolia : latitude(deg) r = -.27 (.0001)
longitude(deg) r = -.21 (.001)
elevation(m) r = .27 (.0001)
cones on first lineal ft of top 25 branches r = .13 (.047)
stem taper inside bark from 6-inch stump to base of live crown(mm/m) r = .19 (.003)

stemwood specific gravity r = -.17 (.010)
stemwood moisture content(pct) r = .21 (.001)
sapwood moisture content(pct) r = .22 (.0004)
stumpwood moisture content(pct) r = .14 (.033)
lateral rootwood moisture content(pct) r = .20 (.002)

Murrayana : there were no significant correlations

13. earlywood radial lumen diameter

Latifolia : latitude(deg) r = -.17 (.007)
longitude(deg) r = -.14 (.034)
elevation(m) r = .17 (.007)
number of live branches r = .13 (.045)
stem taper inside bark from 6-inch stump to base of live crown(mm/m) r = .17 (.010)
crown ratio r = .14 (.030)
stemwood moisture content(pct) r = .17 (.009)
sapwood moisture content(pct) r = .18 (.006)

Murrayana : latitude(deg) r = -.48 (.003)
tree-average percent compression wood in stem r = .39 (.020)

14. latewood radial lumen diameter

Latifolia : latitude(deg) r = -.22 (.001)
longitude(deg) r = -.17 (.008)
elevation(m) r = .22 (.001)
stem crook(mm) r = .14 (.033)
stem taper inside bark from 6-inch stump to base of live crown(mm/m) r = .18 (.006)
stemwood specific gravity r = -.14 (.030)
stemwood moisture content(pct) r = .19 (.003)
sapwood moisture content(pct) r = .20 (.002)
lateral rootwood moisture content(pct) r = .17 (.009)

Murrayana : live crown width(m) r = .35 (.034)
stembark specific gravity r = .33 (.049)

15. earlywood TANG. wall thickness

Latifolia : latitude(deg) r = -.21 (.001)
longitude(deg) r = -.19 (.003)
elevation(m) r = .17 (.009)
heartwood diam at 6-inch stump(mm) r = -.14 (.025)
stemwood specific gravity r = -.14 (.024)
stembark specific gravity r = -.17 (.008)
stemwood moisture content(pct) r = .13 (.046)
stumpwood moisture content(pct) r = .21 (.001)
lateral rootwood moisture content(pct) r = .23 (.0002)
taproot moisture content(pct) r = .21 (.001)

Murrayana : there were no significant correlations

16. latewood TANG. wall thickness

Latifolia : latitude(deg) r = -.14 (.027)
longitude(deg) r = -.13 (.039)
elevation(m) r = .15 (.017)
live crown length(m) r = -.17 (.008)
number of live branches r = -.13 (.043)
taproot moisture content(pct) r = .16 (.013)

stump-root system as fraction of complete-tree ovendry weight r = .15 (.019)

Murrayana : there were no significant correlations

TREE-AVERAGE ANALYSIS FOR LATIFOLIA AND MURRAYANA/STUMP

This section presents results from the correlation analysis for the 8 variables separated into earlywood/latewood. Thus, results are presented for 16 variables. Significant correlations for each of the variables are given (the p-value follows in parentheses). All tests were done at the 5% level. Latifolia has n=243 and Murrayana has n=36.

1. earlywood fiber length

   Latifolia : latitude(deg) r = -.21 (.001)
   longitude(deg) r = -.17 (.007)
   elevation(m) r = .22 (.001)
   stem crook(mm) r = .22 (.0004)
   live branch angle(deg) r = -.14 (.027)
   ovendry heartwood weight(g) r = -.15 (.018)

   Murrayana : there were no significant correlations

2. latewood fiber length

   Latifolia : latitude(deg) r = -.25 (.0001)
   longitude(deg) r = -.17 (.007)
   elevation(m) r = .26 (.0001)
   stembark thickness at 6-inch stump(mm)
   r = -.14 (.035)
   stemwood specific gravity r = -.13 (.045)
   stumpwood moisture content(pct) r = .14 (.032)

   Murrayana : there were no significant correlations

3. earlywood microfibril angle

   Latifolia : latitude(deg) r = -.40 (.0001)
   longitude(deg) r = -.41 (.0001)
   longitude zone r = -.15 (.020)
   elevation(m) r = .41 (.0001)
   stemwood moisture content(pct) r = .17 (.008)
   stumpwood moisture content(pct) r = .24 (.0002)
   lateral rootwood moisture content(pct) r = .23 (.0003)
   taproot moisture content(pct) r = .18 (.006)

   Murrayana : there were no significant correlations

4. latewood microfibril angle

   Latifolia : latitude(deg) r = -.29 (.0001)
   longitude(deg) r = -.36 (.0001)
   longitude zone r = -.28 (.0001)
   elevation(m) r = .32 (.0001)
   stem taper inside bark from 6-inch stump to base
   of live crown(mm/m) r = .14 (.030)
   stemwood specific gravity r = -.14 (.034)
   sapwood moisture content(pct) r = .13 (.047)
   stumpwood moisture content(pct) r = .18 (.005)
   lateral rootwood moisture content(pct) r = .19 (.004)
   taproot moisture content(pct) r = .18 (.006)

   Murrayana : there were no significant correlations

5. earlywood tangential cell diameter

Latifolia : tree-average percent compression wood in stem
r = .15 (.018)

Murrayana : tree-average percent compression wood in stem
r = .44 (.007)

6. latewood tangential cell diameter

Latifolia : there were no significant correlations

Murrayana : longitude(deg) r = .37 (.025)

7. earlywood tangential lumen diameter

Latifolia : tree-average percent compression wood in stem
r = .17 (.009)

Murrayana : tree-average percent compression wood in stem
r = .43 (.009)

8. latewood tangential lumen diameter

Latifolia : there were no significant correlations

Murrayana : live crown length(m) r = .33 (.046)
number of live branches r = .36 (.030)
stemwood moisture content(pct) r = .33 (.048)

9. earlywood RADIAL wall thickness

Latifolia : there were no significant correlations

Murrayana : live crown length(m) r = -.34 (.043)
crown ratio r = -.35 (.038)

10. latewood RADIAL wall thickness

Latifolia : stembark thickness at 6-inch stump(mm)
r = .16 (.012)

Murrayana : taproot length(m) r = -.38 (.021)
live crown length(m) r = -.36 (.031)
tree-average percent compression wood in stem
r = .38 (.023)

11. earlywood radial cell diameter

Latifolia : dbh(mm) r = .16 (.012)
heartwood diam at 6-inch stump(mm) r = .16 (.013)
number of live branches r = .21 (.001)
stem taper inside bark from 6-inch stump to base
of live crown(mm/m) r = .14 (.027)
ovendry stemwood weight(g) r = .16 (.014)
ovendry sapwood weight(g) r = .13 (.044)
ovendry heartwood weight(g) r = .17 (.008)
complete-tree ovendry weight(g) r = .16 (.015)
tree-average percent compression wood in stem
r = .14 (.024)

11. earlywood radial cell diameter(cont.)

Murrayana : tree-average percent compression wood in stem
r = .37 (.025)

12. latewood radial cell diameter

Latifolia : cones on first lineal ft of top 25 branches
r = .13 (.044)

Murrayana : there were no significant correlations

13. earlywood radial lumen diameter

Latifolia : dbh(mm) r = .16 (.013)
heartwood diam at 6-inch stump(mm) r = .16 (.010)
number of live branches r = .21 (.001)
stem taper inside bark from 6-inch stump to base of live crown(mm/m) r = .15 (.020)
ovendry stemwood weight(g) r = .15 (.017)
ovendry heartwood weight(g) r = .17 (.009)
complete-tree ovendry weight(g) r = .15 (.016)
lateral rootwood moisture content(pct) r = -.13 (.042)
tree-average percent compression wood in stem r = .16 (.012)
tree-average e/rl for stemwood r = .13 (.044)

Murrayana : tree-average percent compression wood in stem
r = .37 (.028)

14. latewood radial lumen diameter

Latifolia : there were no significant correlations

Murrayana : there were no significant correlations

15. earlywood TANG. wall thickness

Latifolia : latitude(deg) r = -.17 (.008)
longitude(deg) r = -.18 (.005)
lateral rootwood moisture content(pct) r = .13 (.046)
tree-average e/rl for stemwood r = -.17 (.008)

Murrayana : there were no significant correlations

16. latewood TANG. wall thickness

Latifolia : tree-average e/rl for stemwood r = -.15 (.023)

Murrayana : live/dead branches with no foliage as fraction of complete-tree ovendry weight r = -.35 (.034)

TREE-AVERAGE ANALYSIS FOR LATIFOLIA AND MURRAYANA/TAP ROOT

This section presents results from the correlation analysis for the 8 variables separated into earlywood/latewood. Thus, results are presented for 16 variables. Significant correlations for each of the variables are given (the p-value follows in parentheses). All tests were done at the 5% level. Latifolia has n=243 and Murrayana has n=36.

1. earlywood fiber length

   Latifolia : elevation(m) r = .13 (.047)
   stem crook(mm) r = .19 (.003)
   stembark thickness at 6-inch stump(mm)
   r = -.13 (.044)

   Murrayana : there were no significant correlations

2. latewood fiber length

   Latifolia : latitude(deg) r = -.14 (.024)
   elevation(m) r = .18 (.006)
   stem crook(mm) r = .19 (.003)
   live branch angle(deg) r = -.14 (.035)
   stembark thickness at 6-inch stump(mm)
   r = -.13 (.042)
   cones on first lineal ft of top 25 branches
   r = -.13 (.036)

   Murrayana : there were no significant correlations

3. earlywood microfibril angle

   Latifolia : latitude(deg) r = -.22 (.001)
   longitude(deg) r = -.22 (.001)
   elevation(m) r = .19 (.002)

   Murrayana : there were no significant correlations

4. latewood microfibril angle

   Latifolia : latitude(deg) r = -.26 (.0001)
   longitude(deg) r = -.31 (.0001)
   longitude zone r = -.23 (.0003)
   elevation(m) r = .28 (.0001)
   stemwood moisture content(pct) r = .15 (.023)
   sapwood moisture content(pct) r = .14 (.032)
   stumpwood moisture content(pct) r = .18 (.006)
   lateral rootwood moisture content(pct) r = .17 (.008)
   taproot moisture content(pct) r = .13 (.036)

   Murrayana : dbh(mm) r = .35 (.035)
   live crown width(m) r = .35 (.034)
   live crown length(m) r = .38 (.021)
   ave ring width at 6-inch stump(mm) r = .40 (.017)
   stemwood specific gravity r = -.46 (.004)
   stemwood moisture content(pct) r = .41 (.013)
   sapwood moisture content(pct) r = .47 (.004)
   stumpwood moisture content(pct) r = .33 (.049)

4. latewood microfibril angle(cont.)

Murrayana : stump-root system as fraction of complete-tree ovendry weight r = -.34 (.042)
tree-average percent compression wood in stem r = -.35 (.035)
tree-average e/rl for stemwood r = -.41 (.014)

5. earlywood tangential cell diameter

Latifolia : there were no significant correlations

Murrayana : tree age at 6-inch stump(yrs) r = -.36 (.030)
tree-average percent compression wood in stem r = .43 (.010)

6. latewood tangential cell diameter

Latifolia : cones on first lineal ft of top 25 branches r = .14 (.026)

Murrayana : there were no significant correlations

7. earlywood tangential lumen diameter

Latifolia : live branch angle(deg) r = .13 (.043)

Murrayana : tree age at 6-inch stump(yrs) r = -.37 (.025)
cones on first lineal ft of top 25 branches r = -.34 (.040)
tree-average percent compression wood in stem r = .43 (.009)

8. latewood tangential lumen diameter

Latifolia : cones on first lineal ft of top 25 branches r = .14 (.034)

Murrayana : cones on first lineal ft of top 25 branches r = -.34 (.040)
stemwood moisture content(pct) r = .37 (.027)

9. earlywood RADIAL wall thickness

Latifolia : stembark thickness at 6-inch stump(mm) r = .17 (.009)
central root bark thickness(mm) r = .15 (.020)
stump bark thickness(mm) r = .15 (.018)
ave ring width at 6-inch stump(mm) r = .14 (.029)
cones on first lineal ft of top 25 branches r = .13 (.044)
taproot moisture content(pct) r = .13 (.046)

Murrayana : there were no significant correlations

10. latewood RADIAL wall thickness

Latifolia : foliage as fraction of complete-tree ovendry weight r = -.14 (.030)

Murrayana : there were no significant correlations

11. earlywood radial cell diameter

Latifolia : dbh(mm) r = .14 (.034)
heartwood diam at 6-inch stump(mm) r = .13 (.047)
live crown width(m) r = .14 (.029)
number of live branches r = .19 (.003)
number of dead branches r = .14 (.031)
stembark thickness at 6-inch stump(mm)
r = .21 (.001)

stump bark thickness(mm) r = .16 (.010)
ovendry stemwood weight(g) r = .16 (.010)
ovendry sapwood weight(g) r = .16 (.012)
ovendry heartwood weight(g) r = .14 (.030)
complete-tree ovendry weight(g) r = .16 (.013)

Murrayana : tree-average percent compression wood in stem
r = .42 (.010)

12. latewood radial cell diameter

Latifolia : there were no significant correlations

Murrayana : tree-average percent compression wood in stem
r = .33 (.050)

13. earlywood radial lumen diameter

Latifolia : dbh(mm) r = .13 (.042)
heartwood diam at 6-inch stump(mm) r = .13 (.048)
tree height to apical tip(m) r = .13 (.041)
live crown width(m) r = .13 (.039)
number of live branches r = .18 (.005)
number of dead branches r = .14 (.027)

stembark thickness at 6-inch stump(mm)
r = .19 (.002)
stump bark thickness(mm) r = .15 (.023)
ovendry stemwood weight(g) r = .16 (.012)
ovendry sapwood weight(g) r = .16 (.015)
ovendry heartwood weight(g) r = .14 (.030)
complete-tree ovendry weight(g) r = .16 (.014)

Murrayana : tree-average percent compression wood in stem
r = .43 (.009)

14. latewood radial lumen diameter

Latifolia : elevation(m) r = .14 (.033)

Murrayana : there were no significant correlations

15. earlywood TANG.. wall thickness

Latifolia : stemwood specific gravity r = -.13 (.038)
stemwood moisture content(pct) r = .13 (.036)
stumpwood moisture content(pct) r = .14 (.030)
lateral rootwood moisture content(pct) r = .15 (.017)
taproot moisture content(pct) r = .19 (.003)

15. earlywood TANG. wall thickness(cont.)

Latifolia : stem with bark as fraction of complete-tree ovendry weight r = -.14 (.034)

live/dead branches with no foliage as fraction of complete-tree ovendry weight r = .13 (.049)

Murrayana : crown ratio r = -.35 (.037)

16. latewood TANG. wall thickness

Latifolia : there were no significant correlations

Murrayana : there were no significant correlations

TREE-AVERAGE ANALYSIS FOR LATIFOLIA AND MURRAYANA/LATERAL ROOT

This section presents results from the correlation analysis for the 8 variables separated into earlywood/latewood. Thus, results are presented for 16 variables. Significant correlations for each of the variables are given (the p-value follows in parentheses). All tests were done at the 5% level. Latifolia has n=243 and Murrayana has n=36.

1. earlywood fiber length

   Latifolia : stemwood specific gravity r = -.15 (.019)

   Murrayana : longitude(deg) r = .34 (.043)

2. latewood fiber length

   Latifolia : stem crook(mm) r = .15 (.018)

   Murrayana : number of dead branches r = -.35 (.035)

3. earlywood microfibril angle

   Latifolia : latitude(deg) r = -.27 (.0001)
   longitude(deg) r = -.25 (.0001)
   elevation(m) r = .24 (.0002)
   stembark specific gravity r = -.16 (.013)
   stemwood moisture content(pct) r = .16 (.012)
   stembark moisture content(pct) r = .20 (.002)
   stumpwood moisture content(pct) r = .16 (.011)
   lateral rootwood moisture content(pct) r = .16 (.012)

   Murrayana : live crown width(m) r = -.37 (.024)
   live crown length(m) r = -.43 (.010)
   number of live branches r = -.34 (.041)
   central root bark thickness(mm) r = -.39 (.019)
   ovendry stemwood weight(g) r = -.34 (.041)
   ovendry sapwood weight(g) r = -.34 (.044)
   complete-tree ovendry weight(g) r = -.35 (.034)

4. latewood microfibril angle

   Latifolia : latitude(deg) r = -.25 (.0001)
   longitude(deg) r = -.28 (.0001)
   longitude zone r = -.17 (.008)
   elevation(m) r = .27 (.0001)
   stumpwood moisture content(pct) r = .14 (.029)
   lateral rootwood moisture content(pct) r = .14 (.029)

   Murrayana : dbh(mm) r = .35 (.036)
   live crown width(m) r = .36 (.032)
   stembark thickness at 6-inch stump(mm)
   r = .36 (.032)
   lateral root bark thickness(mm) r = .36 (.032)
   ave ring width at 6-inch stump(mm) r = .39 (.018)
   stem taper inside bark from 6-inch stump to base
   of live crown(mm/m) r = .35 (.036)

4. latewood microfibril angle(cont.)

Murrayana : stemwood specific gravity r = -.39 (.019)
stemwood moisture content(pct) r = .41 (.013)
sapwood moisture content(pct) r = .46 (.005)
lateral rootwood moisture content(pct) r = .40 (.015)

5. earlywood tangential cell diameter

Latifolia : latitude(deg) r = .14 (.025)
longitude(deg) r = .19 (.004)
longitude zone r = .15 (.022)
taproot length(m) r = -.14 (.031)
live branch angle(deg) r = .21 (.001)

stumpwood moisture content(pct) r = -.16 (.014)
lateral rootwood moisture content(pct) r = -.20 (.001)
taproot moisture content(pct) r = -.15 (.024)
stump-root system as fraction of complete-tree ovendry weight r = .16 (.014)

Murrayana : tree-average percent compression wood in stem
r = .41 (.013)

6. latewood tangential cell diameter

Latifolia : taproot length(m) r = -.14 (.030)
stumpwood moisture content(pct) r = -.15 (.022)

Murrayana : longitude(deg) r = .40 (.015)

7. earlywood tangential lumen diameter

Latifolia : latitude(deg) r = .14 (.029)
longitude(deg) r = .18 (.005)
longitude zone r = .14 (.024)
taproot length(m) r = -.13 (.041)
live branch angle(deg) r = .21 (.001)

stemwood specific gravity r = .13 (.044)
stumpwood moisture content(pct) r = -.16 (.012)
lateral rootwood moisture content(pct) r = -.21 (.001)
taproot moisture content(pct) r = -.16 (.013)
stump-root system as fraction of complete-tree ovendry weight r = .15 (.020)

Murrayana : tree-average percent compression wood in stem
r = .40 (.015)

8. latewood tangential lumen diameter

Latifolia : number of dead branches r = -.13 (.044)

Murrayana : longitude(deg) r = .39 (.019)

9. earlywood RADIAL wall thickness

Latifolia : there were no significant correlations

Murrayana : live crown width(m) r = .35 (.035)

10. latewood RADIAL wall thickness

Latifolia : foliage as fraction of complete-tree ovendry weight r = -.18 (.006)

Murrayana : lateral root bark thickness(mm) r = .34 (.045)

11. earlywood radial cell diameter

Latifolia : there were no significant correlations

Murrayana : tree-average percent compression wood in stem r = .40 (.015)

12. latewood radial cell diameter

Latifolia : taproot length(m) r = -.13 (.045)

Murrayana : longitude(deg) r = .37 (.028)

13. earlywood radial lumen diameter

Latifolia : live branch angle(deg) r = .13 (.044)
lateral rootwood moisture content(pct) r = -.13 (.045)

Murrayana : tree-average percent compression wood in stem r = .43 (.009)

14. latewood radial lumen diameter

Latifolia : there were no significant correlations

Murrayana : there were no significant correlations

15. earlywood TANG. wall thickness

Latifolia : taproot moisture content(pct) r = .14 (.025)

Murrayana : foliage as fraction of complete-tree ovendry weight r = -.38 (.021)

16. latewood TANG. wall thickness

Latifolia : elevation(m) r = -.13 (.039)
foliage as fraction of complete-tree ovendry weight r = -.13 (.042)

Murrayana : there were no significant correlations

TREE-AVERAGE VALUES COMPARED --- LATIFOLIA VS. MURRAYANA
for the 8 variables separated into latewood/earlywood, the means for the two varieties were compared using either the t-test or approximate t-test (when variances were unequal); n=243 for Latifolia and n=36 for Murrayana; means are given with standard deviations in parentheses

1. earlywood fiber length (mm)

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	2.11(0.52)	2.64(0.40)	.0001	x
stump	2.38(0.37)	2.52(0.49)	.0962	
tap root	2.08(0.39)	2.34(0.41)	.0004	x
lateral root	1.90(0.36)	2.12(0.47)	.0094	x

2. latewood fiber length (mm)

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	2.66(0.71)	3.59(0.46)	.0001	x
stump	3.10(0.46)	3.14(0.50)	.6215	
tap root	2.70(0.43)	2.78(0.44)	.2879	
lateral root	2.50(0.44)	2.54(0.46)	.6254	

3. earlywood microfibril angle (degrees)

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	27.63(6.40)	26.79(4.66)	.3385	
stump	31.39(4.25)	33.47(5.51)	.0351	x
tap root	33.09(4.69)	34.17(4.62)	.2004	
lateral root	34.75(4.75)	35.47(4.15)	.3903	

4. latewood microfibril angle (degrees)

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	21.79(5.50)	18.42(5.03)	.0006	x
stump	24.12(5.19)	26.44(4.94)	.0120	x
tap root	26.00(4.76)	27.69(4.04)	.0433	x
lateral root	27.95(5.16)	28.89(5.04)	.3100	

5. earlywood tangential cell diameter

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	34.27(3.35)	33.28(4.21)	.1842	
stump	33.36(4.29)	32.97(5.81)	.7037	
tap root	32.74(4.24)	31.58(5.47)	.2294	
lateral root	32.37(4.28)	30.81(4.70)	.0447	x

6. latewood tangential cell diameter

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	27.83(2.98)	28.92(3.23)	.0430	x
stump	27.28(3.94)	28.78(4.24)	.0358	x
tap root	26.51(3.90)	27.47(4.65)	.1774	
lateral root	26.31(4.00)	27.22(4.44)	.2102	

7. earlywood tangential lumen diameter

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	29.52(3.40)	28.98(4.07)	.3834	
stump	29.07(4.31)	29.11(5.77)	.9641	
tap root	28.93(4.25)	27.89(5.65)	.2926	
lateral root	28.71(4.33)	27.31(4.63)	.0733	

8. latewood tangential lumen diameter

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	18.29(3.14)	20.40(3.27)	.0002	x
stump	18.77(3.98)	21.31(4.80)	.0006	x
tap root	18.92(3.89)	20.42(5.20)	.1038	
lateral root	19.05(4.14)	20.58(4.51)	.0419	x

9. earlywood RADIAL wall thickness

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	2.37(0.31)	2.15(0.25)	.0000	x
stump	2.15(0.48)	1.93(0.40)	.0107	x
tap root	1.91(0.40)	1.85(0.43)	.4212	
lateral root	1.83(0.40)	1.75(0.33)	.2579	

10. latewood RADIAL wall thickness

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	4.77(0.52)	4.27(0.56)	.0000	x
stump	4.25(0.65)	3.60(0.65)	.0000	x
tap root	3.77(0.55)	3.39(0.60)	.0001	x
lateral root	3.63(0.49)	3.32(0.48)	.0005	x

11. earlywood radial cell diameter

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	36.16(3.58)	34.69(4.74)	.0805	
stump	35.30(4.43)	34.89(6.90)	.7328	
tap root	34.73(4.81)	33.31(6.18)	.1916	
lateral root	34.33(4.76)	32.64(5.10)	.0504	

12. latewood radial cell diameter

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	20.71(3.50)	21.82(3.37)	.0760	
stump	20.12(4.14)	22.25(4.57)	.0047	x
tap root	19.26(3.87)	21.08(5.09)	.0449	x
lateral root	19.13(3.90)	20.53(4.77)	.1010	

13. earlywood radial lumen diameter

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	32.58(3.61)	31.30(4.62)	.1203	
stump	32.11(4.52)	32.06(6.77)	.9650	
tap root	31.91(4.94)	30.44(6.36)	.1929	
lateral root	31.67(4.80)	30.08(4.82)	.0662	

14. latewood radial lumen diameter

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	13.38(3.65)	15.36(3.65)	.0027	x
stump	13.81(4.32)	16.67(4.85)	.0003	x
tap root	13.53(4.05)	15.83(5.55)	.0213	x
lateral root	13.66(3.98)	15.47(5.22)	.0520	

15. earlywood TANG. wall thickness

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	1.79(0.25)	1.70(0.27)	.0430	x
stump	1.59(0.42)	1.42(0.37)	.0157	x
tap root	1.41(0.41)	1.43(0.40)	.7937	
lateral root	1.33(0.35)	1.28(0.30)	.4074	

16. latewood TANG. wall thickness

	LATIFOLIA	MURRAYANA	p-value	different at 5% level
stemwood	3.66(0.46)	3.24(0.59)	.0002	x
stump	3.15(0.66)	2.79(0.71)	.0026	x
tap root	2.86(0.57)	2.63(0.61)	.0211	x
lateral root	2.74(0.56)	2.53(0.61)	.0396	x

TREE-AVERAGE CORRELATIONS

with earlywood and latewood separated, correlations were computed as above; only correlations significant at the 5% level are reported here; the correlation is given with the p-value in parentheses

1. Latifolia/stemwood

earlywood fiber length with

latewood microfibril angle r = -.26 (.0001)
latewood tangential lumen diam r = .14 (.029)
latewood radial cell diam r = .15 (.023)
latewood radial lumen diam r = .15 (.016)

latewood fiber length with

latewood microfibril angle r = -.25 (.0001)
latewood tangential lumen diam r = .14 (.027)
latewood radial cell diam r = .13 (.044)
latewood radial lumen diam r = .13 (.039)

growth ring width with

earlywood microfibril angle r = -.14 (.026)
latewood microfibril angle r = -.16 (.015)

2. Murrayana/stemwood

latewood fiber length with

latewood microfibril angle r = -.43 (.010)

3. Latifolia/stump

earlywood fiber length with

earlywood microfibril angle r = -.33 (.0001)
latewood microfibril angle r = -.19 (.003)

latewood fiber length with

earlywood microfibril angle r = -.20 (.002)
latewood microfibril angle r = -.34 (.0001)

4. Murrayana/stump

latewood fiber length with

earlywood microfibril angle r = -.40 (.016)

5. Latifolia/tap root

earlywood fiber length with

earlywood microfibril angle r = -.48 (.0001)
latewood microfibril angle r = -.31 (.0001)

5. Latifolia/tap root (cont.)

latewood fiber length with

earlywood microfibril angle r = -.33 (.0001)
latewood microfibril angle r = -.41 (.0001)

6. Murrayana/tap root

earlywood fiber length with

earlywood microfibril angle r = -.37 (.025)

growth ring width with

latewood microfibril angle r = .37 (.027)

7. Latifolia/lateral root

earlywood fiber length with

earlywood microfibril angle r = -.55 (.0001)
latewood microfibril angle r = -.35 (.0001)

latewood fiber length with

earlywood microfibril angle r = -.40 (.0001)
latewood microfibril angle r = -.50 (.0001)

growth ring width with

earlywood tangential cell diam r = -.16 (.013)
latewood tangential cell diam r = -.13 (.043)
earlywood tangential lumen diam r = -.17 (.007)
latewood radial lumen diam r = -.13 (.045)

8. Murrayana/lateral root

growth ring width with

latewood microfibril angle r = .37 (.027)

CONCLUSIONS

PERCENTAGE LATEWOOD

Within Tree

- Variety latifolia stump means were significantly different at different latitudes.
- Variety murrayana showed a significant effect of latitude on percentage latewood at 0 percent height, with 40.0 degrees showing the highest value.
- Variety murrayana showed a significant effect of diameter on latewood percentage, with 3-inch diameter trees exhibiting the greatest mean, occuring at 20 percent of total height.
- With values for all other variables pooled, variety murrayana exhibited significantly greater mean values for latewood percentage at all locations, except the stump and 70 percent height, than did latifolia.

Tree Average--Latewood and Earlywood Combined as in Pulping

- Variety latifoia stemwood and stump means for latewood percentage were significantly affected by latitude, with a generally decreasing value with increasing latitude above 55 degrees. Stump means were also affected by elevation, with an increase in latewood percentage with elevation.
- Variety murrayana stemwood means were affected by latitude, with an initial increase from 37.5 to 40.0 degrees, and then a decrease at 42.5 and 45.0 degrees.
- For the 3 common latitudes, var. murryana stemwood latewood percentage means are greater than those of latifolia.
- When values from all latitudes are pooled, variety murrayana stemwood, taproot and lateral root latewood percentages were significantly greater than those of latifolia.

RESIN CANAL NUMBER/CM^2

Within Tree

- Variety latifolia stemwood (40 percent height) and taproot mean resin canal numbers were significantly affected by latitude.
- Variety latifolia stemwood (40 percent height) means were significantly affected by elevation.
- Variety murrayana latitude means for stemwood (0, 10 and 70 percent height) resin canal number were significantly different.
- Variety murrayana stemwood (10 percent) resin canal number means were significantly affected by latitude.
- With data for all trees pooled, resin canal numbers for latifolia were significantly greater than murrayana in the lateral root, tap root, stump and 40 percent height.

Tree Average--Latewood and Earlywood Combined as in Pulping

- Variety latifolia latitude means for stemwood canal number were significantly different.
- Variety murrayana latitude means for stemwood canal number were also significantly different, with 37.5 degrees having the highest and 42.5 degrees the lowest values.
- Variety murrayana diameter means for stemwood resin canal number were significantly different, with 76mm (3-inch) the greatest and 152mm (6-inch) the least.
- For the 3 common latitudes, latifolia lateral roots had significantly more resin canals than murrayana.
- With data for all trees of each variety pooled, latifolia had significantly more resin canals than murrayana in the stump, tap and lateral roots.

RESIN CANAL DIAMETER

Within Tree

- At 80 percent stemwood height, latitude means were significantly different for latifolia.
- At 0, and above 40 percent heights and above, murrayana latitude means were significantly different, with resin

canal diameter increasing with increasing latitude, peaking at 42.5 degrees.

- With data for all trees of each variety pooled, resin canal diameter for murrayana differed from that of latifolia only at the lateral root and 50-70 percent heights, with murrayana having the larger canals.

Tree Average--Latewood and Earlywood Combined as in Pulping

- Mean values for latifolia stemwood, stump and lateral roots showed no main effect or interaction differences.

- Mean values for murrayana stemwood and tap root canal diameters showed a positive relationship with latitude.

- For the 3 common latitudes, variety means for stemwood, stump and taproot showed no significant differences betweem the two, but latifolia's lateral root resin canal diameters were significantly smaller than those of murrayana.

- With data for the varieties pooled, variety means for murrayana lateral roots resin canal diameters were greater than those of latifolia.

TRACHEID LENGTH

Within Tree

- Variety latifolia latitude means for stump earlywood tracheid length varied significantly.

- Variety latifolia generally showed a uniform earlywood tracheid length throughout the tree until a decrease at about the 70 percent height in the stem.

- Variety latifolia tap and lateral root means for latewood tracheid length varied by latitude.

- Variety murrayana displayed an increase in latewood tracheid length from 37.5 degrees to 40.0 degrees latitde, and then decreased at 42.5 and 45 degrees.

- Variety murrayana generally showed an increase in earlywood tracheid length from lateral root to 10 percent height, a uniform length to 60 percent and then a decrease.

- Variety murrayana stemwood, taproot and lateral root means for earlywood tracheid length were all longer than

those of latifolia at the same latitudes.

- When the varieties were compared at each location in the tree, earlywood tracheid lengths for murrayana were significantly greater at all locations except the stump, and lengths of murrayana latewood tracheids were greater at all above-ground locations.

Tree Average--Latewood and Earlywood Combined as in Pulping

- Variety latifolia stumpwood tracheid length means were significantly higher in the middle latitudes.

- With diameters and latitudes pooled, murrayana taproot and lateral root mean tracheid lengths were greater than those of latifolia.

- When values for all other variables were pooled, variety means for murrayana stemwood, taproot and lateral root were significantly greater than those of latifolia.

Tree Average--Latewood and Earlywood Separated

- Variety latifolia stumpwood means for earlywood tracheid length varied by latitude.

- Variety latifolia taproot and lateral root means for latewood tracheid length varied by latitude.

- Variety murrayana taproot and lateral root earlywood means were significantly greater than those of latifolia.

- When values for the other variables were pooled, murrayana stemwood, taproot and lateral root earlywood tracheid length means are greater than those of latifolia.

- When values for the other variables are pooled, murryana stemwood latewood tracheid length means are greater than those of latifolia.

MICROFIBRIL ANGLE

Within Tree

- Variety latifolia stump and lateral root means for earlywood microfibril angle were significantly different at the different latitudes.

- Variety murrayana stemwood (0-90 percent) means were effected by latitude, with 37.5 degrees having the

smallest angle and 40.0 degrees usually the largest.

- Variety latifolia latitude means for taproot latewood microfibril angle were significantly different.

- Variety murrayana latitude means for stemwood (0-90 percent) latewood microfibril angle means were different, with 37.5 degrees always the least and 42.5 or 45 degrees the largest.

- Both varieties showed within-tree trends of decreasing earlywood and latewood microfibril angle from lateral root to groundline, and then relatively stable values until reaching approximately 50-60 percent height, where the values decreased slightly.

- With data for all trees pooled, earlywood microfibril angle for latifolia was greater than murrayana at 60 percent, and smaller than that of murrayana at the stump.

- With data for all trees pooled, latewood microfibril angle for murrayana was greater than that of latifolia in the tap root and stump, while at all above-ground locations, latifolia had the higher value.

Tree Average--Latewood and Earlywood Combined as in Pulping

- Variety latifolia latitude means for stump and lateral root microfibril angle were significantly different, with a slight positive correlation.

- Variety murrayana latitude means for stemwood were different, with a neutral correlation.

- Pooled data for the common latitudes showed that mean values for of microfibril angles of both varieties were not significantly different from each other.

- Pooled data for all latitudes of both varieties showed that mean values for taproot microfibril angle were not significantly different.

Tree Average--Latewood and Earlywood Separated

- Variety latifolia latitude means for stump and lateral root earlywood microfibril angle were significantly different.

- Variety latifolia latitude means for lateral root latewood microfibril angle were significantly different.

- Variety murrayana latitude means for stemwood earlywood

and latewood microfibril angle were significantly different.

- With all trees' data pooled for each variety, murrayana stump earlywood tracheids had significantly larger microfibril angles than those of latifolia.

- With all trees' data pooled for each variety, latifolia stemwood latewood tracheids had significantly larger microfobril angles than those of murrayana. This relationship coincides with murrayana's greater above-ground tracheid lengths.

- With all trees' data pooled for each variety, murrayana stump and tap root latewood tracheids had significantly larger microfibril angles than latifolia. The accepted negative correlation of tracheid length and microfibril angle is seen within each variety, but not between varieties.

- With all trees' data pooled for each variety, murrayana showed positive correlations with latitude and longitude, and a strong negative correlation with elevation.

TANGENTIAL CELL AND LUMEN DIAMETERS

Within Tree

- Variety latifolia latitude means for stemwood (0 percent),taproot and lateral root earlywood tangential cell diameter were significantly different.

- Variety latifolia diameter means for stemwood (80 percent) earlywood tangential cell diameter were significantly different.

- Variety murrayana latitude means for stemwood and lateral root tangential cell diameter were significantly different.

- Tangential earlywood cell diameter showed a general increase, for both varieties, with increasing height in the tree.

- Variety latifolia latitude means for stemwood (0, 70 percent), stump and tap root latewood tangential cell diameters were significantly different.

- Variety murrayana stemwood (30, 50, 80. 90 percent) latewood tangential cell diameter varied by latitude, with 40.0 degrees having the highest value, and 37.5 degrees usually having the lowest.

- Tangential latewood cell diameter showed a general increase, for both varieties, with increasing height in the tree.

- Variety latifolia latitude means for stemwood (0 percent), taproot and lateral root earlywood tangential lumen diameter were significantly different.

- Variety latifolia diameter means for stemwood (80 percent) earlywood tangential lumen diameter were significantly different.

- Variety murrayana latitude means for stemwood (10, 20, 30 and 90 percent) and lateral root earlywood tangential lumen diameter were different, with 45.0 degrees having the smallest.

- Variety latifolia latitude means for stump latewood tangential lumen diameters were significantly differernt.

- Variety murrayana latitude means for stemwood (30, 50, 80 and 90 percent), taproot and lateral root latewood tangential lumen diameters were significantly different, with 40.0 degrees having the largest and 37.5 or 45.0 degrees having the smallest.

- Earlywood and latewood tangential lumen diameter showed a general increase, for both varieties, with increasing height in the tree.

- With all trees pooled for each variety, both earlywood tangential cell and lumen diameters of latifolia differed from those of murrayana only at the 30 percent height of the stem, with latifolia showing slightly larger cell and lumen diameters.

- With all trees pooled for each variety, murrayana showed larger latewood tangential cell diameters at the stump and from 40 to 80 percent of tree height, than did latifolia.

- With both varieties's data pooled, murrayana latewood tangential lumen diameters were larger than those of latifolia, except in tap root and at 30 and 90 percent of stem height.

Tree Average--Latewood and Earlywood Combined as in Pulping

- Variety latifolia latitude means for stemwood, taproot and lateral root tangential cell diameter were significantly different, showing a slightly negative correlation.

- Variety murrayana latitude means for stemwood and lateral root tangential cell diameter were significantly different, exhibiting a slightly negative correlation.

- No differences existed in stemwood, stump, taproot and lateral root tangential cell diameter means when variety data were pooled and tree-average values for variety were compared.

- Variety latifolia latitude means for taproot tangential lumen diameter were significantly different, with relatively uniform values for 40.0 through 52.5 degrees, a peak at 55 degrees and lower values at 57.5 and 60.0 degrees.

- Variety murrayana latitude means for lateral root tangential lumen diameters were significantly different with 40.0 degrees high, 37.5 and 42.5 low and 45 degrees intermediate.

- For the three common latitudes, and also all latitudes, no significant differences in the tangential lumen diameters of the two varieties were seen.

Tree Average--Latewood and Earlywood Separated

- Variety latifolia latitude means for stemwood, taproot and lateral root earlywood tangential cell diameter were significantly different.

- Variety murrayana lateral root by latitude earlywood tangential cell diameter means were significantly different.

- For the three common latitudes, pooled data values for each variety showed the earlywood tangential cell diameters of latifolia to be significantly larger than those of murrayana.

- In the three common latitudes, variety latifolia stemwood, stump and taproot latewood tangential cell diameters were larger than those of murrayana.

- Pooling all values for each variety, murrayana stemwood and stump latewood tangential cell diameters were larger than those of murrayana.

- Variety latifolia latitude means for stemwood, taproot and lateral root earlywood tangential lumen diameters were significantly different.

- Variety murrayana latitude means for stemwood and lateral

root earlywood tangential lumen diameters were significantly different.

- Variety latifolia latitude means for stump latewood tangential lumen diameter were significantly different.

- Variety murrayana latitude means for taproot and lateral root latewood tangential lumen diameters were significantly different.

- Pooling values for each variety for the three common latitudes showed murrayana stemwood latewood tangential lumen diameters to be greater than those of latifolia.

- Pooled data for all latitudes for both varieties showed murrayana stemwood, stump and lateral root latewood tangential lumen diameters to be larger than those of latifolia.

RADIAL CELL AND LUMEN DIAMETER

Within Tree

- Variety latifolia latitude means for stemwood (0, 10 and 20 percent) earlywood radial cell diameter were significantly different.

- Variety latifolia tree diameter means for stump earlywood radial cell diameter were significantly different.

- Variety murrayana latitude means for stemwood (all but 70 percent) earlywood radial cell diameter were significantly different with 40.0 degrees usually having the greatest mean and 42.5 degrees with the smallest.

- Both latifolia and murrayana showed a positive relationship of earlywood radial cell diameter with position in the tree.

- Variety latifolia latitude means for stemwood (0, 20, 30 - 50 and 90 percent), stump and tap root latewood radial cell diameter were significantly different.

- Variety murrayana latitude means for stemwood (except 10, 20 and 60 percent) latewood radial cell diameter were significantly different, with 40.0 degrees having the largest diameters and 45.0 degrees usually having the smallest.

- Both latifolia and murrayana showed a positive relationship between latewood radial cell diameter and position in the tree.

- Variety latifolia latitude means for stemwood (0 and 10 percent) earlywood radial lumen diameter differed significantly.

- Variety latifolia diameter means for stemwood (40 percent) earlywood radial lumen diameter were significantly different.

- Variety murrayana latitude means for stemwood (0-60-and 80 percent) and tap root earlywood radial lumen diameters were significantly different, with trees at 40.0 degrees usually having the largest diameters and those at 42.5 or 45.0 having the smallest.

- Both varieties showed a slight positive relationship of earlywood radial lumen diameter with height in tree.

- Variety latifolia latitude means for stemwood (0, 20-50 and 90 percent), stump and tap root latewood radial cell lumen diameter were significantly different.

- Variety murrayana latitude means for stemwood (0, 30-50 and 80 percent) latewood radial lumen diameters were significantly different, with trees at 40.0 degrees having the largest diameters and those at 45.0 degrees having the smallest.

- Variety murrayana diameter means for stemwood (10 and 40 percent) latewood radial lumen diameter were significantly different, with the 228mm trees having larger lumen diameters than the other 2 diameter-classes.

- Pooled data for all trees showed that variety-average earlywood tangential cell diameters of latifolia differed from those of murrayana only at the lateral root and 30 percent level, with latifolia having the larger diameters.

- Pooled data for all trees showed that variety-average latewood tangential cell diameters of murrayana differed from those of latifolia at the stump and 40-80 percent levels, with murrayana having the larger tangential cell diameters.

- Pooled data for trees of both varieties, showed that earlywood radial cell diameters of latifolia differed from those of murrayana at 10 and 20 percent levels, with latifolia having the larger diameters.

- Pooled data for trees of both varieties showed that latewood radial cell diameters of murrayana differed from those of latifolia at 50-90 percent levels, with murrayana having the larger cell diameter.

- Pooled data for trees of both varieties showed that earlywood tangential lumen diameters of latifolia differed from those of murrayana only at the 30 percent level, with latifolia having the greater.

- Pooled data for trees of both varieties showed that latewood tangential lumen diameters of murrayana differed from those of latifolia at all locations except the tap root, 30 and 90 percent levels, with murrayana having the larger lumen diameters.

- Pooled data for trees of both varieties showed that earlywood radial lumen diameters of latifolia differed from those of murrayana only at the 20 percent level, with latifolia having the larger lumen diameter at this level.

- Pooled data for trees of both varieties showed that variety-average latewood radial lumen diameters of murrayana differed from those of latifolia at all levels except the lateral root, 0 and 30 percent levels, with murrayana having the larger lumen diameters.

Tree Average--Latewood and Earlywood Combined as in Pulping

- Variety latifolia latitude means for stemwood radial cell diameter were different, showing a slight decrease in diameter with increasing latitude.

- Variety murrayana latitude means for stemwood amd tap root radial cell diameter were significantly different, with trees at latitude 40.0 degrees showing larger diameters than trees from the other 3 sampled latitudes.

- Comparisons of the main effect means of the two varieties at the 3 common latitudes showed no signifcant differences in radial cell diameter.

- Comparing pooled data for all trees, lateral root wood of latifolia had slightly larger radial cell diameters than did murrayana.

- Variety murrayana latitude means for stemwood and tap root radial lumen diameter were significantly different, with trees from latitude 40.0 degrees having the largest diameters and those from 42.5 or 45.0 degrees having the smallest.

- Comparison of the two varieties at the common latitudes revealed that stemwood radial lumen diameter of murrayana was greater than that of latifolia at 40.0 degrees, but was smaller at 42.5 and 45.0 degrees.

- Pooling data for all trees studied of both varieties reveals no significant differences in radial cell diameter.

Tree Average--Latewood and Earlywood Separated

- Variety latifolia latitude means for stemwood and stump earlywood radial cell diameter were significantly different.

- Variety murrayana latitude means for stemwood earlywood radial cell diameter were significantly different.

- For the 3 common latitudes, no varietal differences were seen for earlywood radial cell diameter.

- Pooled data for all trees studied showed no significant varietal differences in earlywood radial cell diameter.

- Variety latifolia latitude means for stemwood, stump, and lateral root latewood radial cell diameter were significantly different.

- Variety murrayana latitude means for stemwood latewood radial cell diameter were significantly different.

- Variety latifolia stemwood and stump latewood radial cell diameters were significantly different from those of murrayana at the 3 common latitudes. Variety murrayana exhibited the higher values.

- Pooling data for all trees studied showed that murrayana stump and lateral root latewood radial cell diameter means were significantly larger than those of latifolia.

- Variety latifolia latitude means for stemwood earlywood radial cell lumen diameter were significantly different.

- Variety murrayana latitude means for stemwood and tap root earlywood radial lumen diameter means were significantly different.

- For the three common latitudes, no main-effect varietal differences in radial lumen diameter were found.

- For all latitudes, no main-effect varietal differences in radial lumen diameter were found.

- Variety latifolia latitude means for stemwood, stump and lateral root latewood radial lumen diameter were significantly different.

- Variety murrayana stemwood latewood radial lumen diameter means were significantly different.

- For the 3 common latitudes, latifolia stump and tap root latewood radial cell lumen diameter means were greater than those of murrayana.

- With data pooled for all latitudes, no significant varietal differences in radial lumen diameter were found.

RADIAL AND TANGENTIAL WALL THICKNESSES

Within Tree

- Variety latifolia latitude means for stemwood (40-60 and 90 percent) earlywood radial cell wall thickness were significantly different.

- Variety latifolia elevation means for stemwood (50 and 60 percent) earlywood radial cell wall thickness were significantly different.

- Variety latifolia latitude means for stemwood (30 percent), stump and lateral root earlywood tangential wall thickness differed significantly.

- Variety latifolia latitude means for stemwood (0, 20-50 and 80 percent) latewood tangential wall thickness were significantly different.

- Variety latifolia diameter means for stemwood (0 and 50 percent) latewood tangential wall thicknesses were significantly different.

- Earlywood tangential wall thicknesses for both varieties were lowest in the below-ground portions, increased and stabilized from approximately the 10 percent height to the 70 percent height level, and then decreased slightly.

- Latewood tangential wall thicknesses for both varieties were lowest in the below-ground portions, increased continually to peak values at approximately 20 percent of stem height, gradually decreasing to values roughly equivalent to those at the 0-10 percent levels.

- With data for all trees pooled, varietal differences in earlywood radial wall thickness occurred at the stump and stemwood (0-30 and 50 percent), with latifolia exhibiting higher values than murrayana.

- Pooled data for all trees showed latifolia latewood radial wall thicknesses to be greater than those of murrayana at all locations except the 80 and 90 percent levels.

- Pooled data for all trees showed that latifolia earlywood tangential wall thicknesses were larger than those of murrayana only at the stump and 0 percent of stem height. Otherwise, no other differences in this variable were seen.

- Pooled data for all trees showed that latifolia latewood tangential wall thicknesses were larger than those of murrayana at all locations except 70-90 percent of tree height.

Tree Average--Latewood and Earlywood Combined as in Pulping

- Variety latifolia lateral root radial wall thickness by latitude means were significantly different.

- Variety latifolia stemwood, stump, and lateral root tangential wall thickness by latitude means were significantly different.

- Variety murrayana stemwood radial wall thickness by latitude means were significantly different, while tap root radial wall thickness by diameter means were significantly different.

- With data pooled and compared for the common latitudes, the 152 mm-diameter trees had significantly thicker radial walls than did the 76 or 228mm trees.

- With data pooled and compared for all trees studied, stemwood and stump wood of latifolia has thicker tangential and radial walls.

Tree Average--Latewood and Earlywood Separated

- Variety latifolia latitude means for stump latewood radial wall thickness were significantly different.

- Variety latifolia latitude means for stemwood, stump and lateral root earlywood tangential cell wall thickness stemwood were significantly different.

- Variety latifolia latitude means for stemwood latewood tangential wall thickness were significantly different.

- Variety latifolia diameter means for tap root latewood tangential wall thickness were significantly different.

- Variety murrayana latitude means for stemwood earlywood radial cell wall thickness were significantly different.

- Variety murrayana diameter means for tap root earlywood radial cell thickness were significantly different.

- With data pooled for all trees, murrayana had significantly thicker stemwood and stump earlywood radial wall thickness means than did latifolia.

- With data pooled for all trees, latifolia latewood radial wall thickness means at all locations were significantly thicker than those of murrayana.

- With data pooled for all trees, latifolia stemwood and stump earlywood tangential wall thickness means were greater than those of murrayana.

- With data pooled for all trees, latifolia stemwood, stump and lateral root latewood tangential wall thicknesses were greater than those of murrayana.

- With data pooled for all trees, murrayana displayed thicker latewood tangential walls at all locations than did latifolia.